THE WEEK'S EVENTS

Tunnel Blast Kills Ten at Baltimore

Premature explosion in Gunpowder Falls-Montebello aqueduct occurs as dynamite is loaded

In the most deadly tunneling disaster in recent times, ten men lost their lives when part of the dynamite being loaded into drill holes in the Gunpowder Falls-Montebello water tunnel in Baltimore exploded prematurely at the end of the graveyard shift on July 20. All of those killed were negro miners employed by the J. F. Shea Company, contractor on the 6.6-mile bore being driven for the city of Baltimore. Seven others in the heading at the time were injured, three of them seriously, by the sudden blast. Among the injured are Philip Lesser, explosives inspector for the city, and John Reed, shift boss.

The explosion occurred in the single heading being driven from the Montebello shaft, 165 ft. deep at the outlet end of the tunnel. This heading had advanced about 5,000 ft. from the shaft, and will soon meet another heading under way from Louise shaft. The exact cause of the blast has not yet been determined, and probably never will be, though investigations are being conducted by five different agencies.

Holes partly loaded

According to the survivors, the full-face round of 49 holes was drilled out about 6:30 a.m. and loading of the holes began at once. Eight cases, 400 lb. of dynamite, were brought into the heading on a car pulled by a storage-battery locomotive. About half of the powder had been transferred from the car to the steel-pipe drill jumbo from which loading was being done. Evidence after the blast indicates that the first stick—a cushion charge without primer—had been placed in about half of the holes, though not yet tamped down in most cases. Several loose sticks of dynamite were on the front platforms of the jumbo, and were undisturbed by the explosion.

Apparently only a stick or two of powder in one hole and a few loose sticks on the jumbo exploded, for the face of the heading was found intact except for a shallow 4-in. enlargement at the collar of one hole. The jumbo frame adjacent to this hole was badly wrecked. More than 7½ cases of dynamite were recovered, showing that less than half a case went off. Numerous loosely-placed sticks in hole collars were undisturbed.

All safety precautions were being followed, and this marks the first serious accident in driving over 30,000 ft. of heading on the job. All those handling explosives were experienced tunnel men. Lights and power had been cut off in the heading, and loading was proceeding by safety flashlights, as is customary on safely-conducted tunnel projects.

The tunnel, 12 ft. finished diameter, is being driven in six headings from three shafts and a portal. Chas. Kavenaugh is general superintendent, assisted by Philip Dailey.

ENR staff photo

Fifty Years an Editor

In selecting news pictures for this issue, no photo of a bridge dedication, a sewage plant opening, or a contract signing seemed as newsworthy or significant as this camera study of Charles S. Hill, associate editor of *Engineering News-Record*, who is just completing his fiftieth year of service to technical journalism. The words the "Judge" has put down, one after another, since he joined the old *Engineering News* in 1888, have, we choose to believe, influenced the course of construction development. His keen analysis in the Nineties of the novel excavating machines and methods on the Chicago Drainage Canal inspired many later improvements. The infant art of reinforced concrete, now grown to such large proportions, was aided by his books at the turn of the century. As late as 1928, his articles and book on Winter Construction fostered a disregard for "Old Man Winter".

A lifelong student of construction practices, of roadbuilding and of flood control work, Hill needs no introduction to the readers of this journal. His next important contribution will be a series of six articles on stabilized soil roads in the South, to begin in September. And he got them the hard way—by going out after them. Thus, it may be noted, the above pose at his desk, while characteristic, is not necessarily typical; a good many weeks of the year will find him in the field with his construction boots on.

New Loan Contracts For Housing Made

New agreements bring total loans contracted for by USHA to over a million and a half

The U. S. Housing Authority has contracted with thirteen more local housing authorities to loan sums aggregating $43,458,000 to cover 90 per cent of the cost of proposed slum clearance and low rent housing projects. These thirteen contracts bring the total amount of USHA loan contracts to $154,528,000 for 28 cities. In addition to this amount actually contracted for, USHA has earmarked $352,343,000 for 95 additional cities. These earmarkings are not definite allotments and are not based on specific projects, but are intended to give local authorities a basis on which to plan their projects. In all, a total of $560,871,000 is provided for in commitments to 123 cities.

Largest of the new contracts is that with the Philadelphia Housing Authority for $15,118,000. Details on the projects involved are shown in the accompanying table. The cost per dwelling unit includes only actual cost of construction, while the total cost given includes in addition land, non-dwelling facilities, and architectural and overhead charges.

NEW U.S.H.A. LOAN CONTRACTS

City	Dwelling Units	Cost per Unit	Total Cost	Federal Loan.	Shelter rents per room per month
St. Petersburg, Fla.	240	$2,910	$1,065,000	$959,000	$4.00
Tampa, Fla.	350	3,075	1,603,000	1,524,000	3.75
Peoria, Ill.	540	3,330	2,843,000	2,559,000	...
Louisville, Ky.	790	3,270	4,650,000	4,185,000	3.75
Detroit, Mich.	440	3,950	2,564,000	2,307,000	4.50
Omaha, Neb.	520	3,100	2,492,000	2,243,000	...
Dayton, Ohio	600	3,225	2,916,000	2,624,000	4.00 to 4.25
Toledo, Ohio	380	3,185	1,827,000	1,644,000	4.50
Philadelphia, Pa.	2,980	3,500	16,800,000	15,118,000	...
Knoxville, Tenn.	560	2,990	2,782,000	2,504,000	...
San Antonio, Texas	1,250	2,200	3,986,000	3,588,000	2.00
Fort Worth, Texas	500	2,825	2,253,000	2,028,000	2.75 to 3.00
Charleston, W. Va.	500	3,200	2,416,500	2,475,000	...
	9,650		$48,287,500	$43,458,000	

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Pacific Coast convention, Portland, Aug. 9-12.

INTERNATIONAL CONGRESS FOR INDUSTRIAL ACCIDENTS AND OCCUPATIONAL DISEASES, Frankfort-on-the-Main, Germany, Sept. 26-30.

AMERICAN PUBLIC WORKS ASSOCIATION, annual meeting, New York City, Oct. 3-5.

NATIONAL SAFETY COUNCIL, annual congress, Stevens Hotel, Chicago, Oct. 10-14.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual convention, French Lick Springs, Ind., Oct. 10-14.

NATIONAL RECLAMATION ASSOCIATION, annual meeting, Reno, Nev., Oct. 11-13.

AMERICAN SOCIETY OF CIVIL ENGINEERS, fall meeting, Rochester, N. Y., Oct. 12-14.

LOCAL AND REGIONAL

WESTERN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual convention, Reno, Nev., Aug. 10–13.

AMERICAN WATER WORKS ASSOCIATION, local section meetings scheduled: Central States, Wheeling, Aug. 17-19. New York, Poughkeepsie, Sept. 22-23. Wisconsin, Milwaukee, Oct. 10-12.

NEW ENGLAND WATER WORKS ASSOCIATION, annual convention, Hotel Statler, Boston, Sept. 13-16.

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Proposed Architectural Fees Submitted to USHA

Acting at the request of U.S.H.A. Administrator Straus, the American Institute of Architects has submitted a schedule of fees for design and supervision services on public housing projects. The suggested fees would include "normal" engineering and landscaping services, but where special structural questions, such as earthquake resistance, arise, or where special foundations or more than one basement are required, would call for extra pay.

The suggested fees start at 5 per cent for a project costing $100,000 and drop to 4.3 per cent for a $2,000,000 project; to 3.1 per cent for a $5,000,000 project; and to 2.5 per cent for a $10,000,000 project.

The committee of the A.I.A. which prepared the schedule consisted of Walter R. McCornack, Cleveland; Richmond H. Shreve, New York City; C. C. Zantzinger, Philadelphia; William Stanley Parker, Boston; and Frederick W. Garber, Cincinnati.

Housing Architects Sign with CIO

Contract recognizes FAECT as bargaining agent for technical employees and wages will be set

The Queensbridge Project Associated Architects, a New York City firm which holds the design contract on Queensbridge Houses, USHA financed project of the New York City Housing Authority, signed a contract on July 19 with the Federation of Architects, Engineers, Chemists and Technicians, CIO affiliate, recognizing the union as collective bargaining agent for all employees of the firm.

The contract, signed on behalf of the firm by W. F. R. Ballard, chief architect, provides for recognition of the union, payment of time and one-half for overtime and double time on holidays and Sundays, vacations for all employees at the rate of one day for each month of employment. The firm agrees to give a week's notice of dismissal and to make dismissals in order of seniority. The federation's chief steward in the employ of the firm is to be given preferential seniority, through it is provided "that this section shall be interpreted in the light of recognized architectural practice."

The agreement outlaws strikes and lockouts and provides for compulsory arbitration of disputes.

The contract as now signed does not contain any wage and hour provisions. Hour standards, a salary schedule, and a schedule of percentages of employees to be assigned to each classification, are to be agreed on in joint consultation among the firm, the New York City Housing Authority, and the federation before Aug. 1.

A schedule of prevailing wages for architectural employees on housing projects in the New York City area has been established by the U. S. Housing Authority, in accordance with the provision in the housing act that prevailing wages be paid on all housing projects. The schedule requires a weekly wage of $70 for senior draftsmen, $55 for draftsmen, $52 for junior draftsmen, $40 for sub-junior draftsmen, and $25 for apprentices. These are figured on the basis of a 40-hour week.

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License Change Killed

An amendment to the Louisiana registration law (*ENR*, June 2, 1938, p. 765) which would have set up a professional engineer's license rather than the present civil engineer's license, has been withdrawn and is dead for the present session of the legislature.

Coast Lumber Dealers Restrained by FTC

Six associations of retail lumber dealers in California have been ordered by the Federal Trade Commission to cease and desist from attempting to restrict retail lumber trade to members of the associations and to set prices. The order is directed against the California Lumbermen's Council, Fresno, and its affiliated units: Coast Counties Lumbermen's Club; Central Valley Lumbermen's Club; Northern Counties Lumbermen's Club; Peninsula Lumbermen's Club; and San Joaquin Lumbermen's Club.

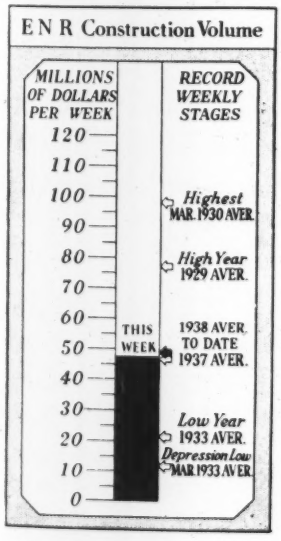
FTC findings indicated that the association attempted, by boycotts and threats of boycott directed against manufacturers, to confine retail distribution of lumber exclusively to members of the organization and to prevent direct sales to non-members, including state and other public bodies. Two clubs prepared lists of prices to be charged, and one set of sales quotas for manufacturers and club members.

CONTRACTS AND CAPITAL

ENGINEERING construction awards for the week, $48,716,000, are 8 per cent above last week and 3 per cent above the volume for the corresponding 1937 week. Private awards are 45 per cent above a week ago, but 35 per cent below the 1937 week. Public construction is 2 per cent below the preceding week, but 33 per cent above the week a year ago.

Construction volume for 1938 to date totals $1,478,264,000, a decrease of 2 per cent from the $1,505,429,000 reported for the corresponding period a year ago.

Unclassified construction is at its highest level of the year due to a subway contract in Brooklyn, N. Y., a transmission line project in Washington and Oregon, and a railroad track relocation program in Oregon, the three of which total $7,801,000. Waterworks, sewerage, industrial buildings, commercial buildings, public buildings, streets and roads report gains over last week. Waterworks, sewerage, commercial buildings, streets and roads and unclassified construction are above the corresponding figures a year ago.



New construction capital for the week, $108,866,000, is 196 per cent above the volume for the corresponding 1937 week. This brings the total for the 30 weeks of 1938 to $2,487,402,000, 268 per cent above the 30-week 1937 period. The week's financing includes $43,458,000 in USHA loans to 13 cities; $29,121,000 in PWA allotments for non-federal projects; $16,329,000 in PWA allotments for federal projects; $10,858,000 in state and municipal bonds; and $9,100,000 in corporate security issues.

CONTRACTS

(Thousands of dollars)

	Week Ending July 29 1937	July 21 1938	July 28 1938
Federal	$3,918	$9,594	$2,897
State & Municipal	22,545	26,098	32,264
Total public	$26,463	$35,692	$35,161
Total private	20,930	9,343	13,555
TOTALS	$47,393	$45,035	$48,716
Cumulative 1938 (30 weeks)			$1,478,264
1937 (30 weeks)			$1,505,429

Note: Minimum size project included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	1937 30 Wk.	Cumulative 1938 30 Wk.
NON-FEDERAL	$917,760	$1,337,222
State & Mun. bonds	341,124	382,122
Corporate securities	334,662	201,038
PWA loans, grants	12,035	321,514
RFC loans	29,939	64,891
U.S.H.A. loans	....	154,528
R.E.A. loans	....	11,629
Federal Aid-Highways	200,000	201,500
FEDERAL	$57	$1,150,180
TOTAL CAPITAL	$917,817	$2,487,402

FHA MORTGAGES

	1937 29 Wk.	Cumulative 1938 29 Wk.
Mortg. selected for appraisal	$381,331	$529,255

ENR INDEX NUMBERS

Index Base		1913	1926
Construction Cost	July	232.29	111.66
Building Cost	July	194.39	105.08
Volume	June	166	73

Glass Monopoly Charged In St. Louis

Four St. Louis glass companies and two labor unions there have been charged with conspiracy to monopolize the glass business in a complaint issued by the Federal Trade Commission July 18. The commission asserts that the price of glass has been increased 35 to 50 per cent above normal through the operation of a price fixing committee.

The commission alleges that the four companies apportion business among themselves; force competitors to buy from them at prices above those quoted by manufacturers; prevent sash and door manufacturers from installing glass at their factories; and prevent competitors from obtaining union workmen to install glass. The four companies and the two unions, according to the commission, have an agreement compelling the companies' competitors to hire more glaziers than they need.

The companies named in the complaint are the Pittsburgh, Murre, Burroughs and Hadley-Dean glass companies. The unions are District Council No. 2 and Glaziers Local No. 513 of the Brotherhood of Painters, Decorators and Paperhangers.

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Gas Tax Diversion Control Defeated in New York

The New York State Constitutional Convention on July 26 voted down a proposed constitutional amendment which would have reserved at least half of the income from gasoline taxation for highway purposes. The amendment would have reserved to the highway fund at least two cents of any gasoline tax imposed and half of any tax greater than four cents.

The amendment had been favorably reported by the convention's committee on highways but had been attacked by the committee on state finances and also by Governor Lehman, both the committee and the governor asserting that it was unsound to earmark revenues in the constitution.

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Crowe Is Superintendent At Shasta Dam

Frank T. Crowe has been announced as general superintendent for Pacific Constructors, Inc., on the construction of Shasta Dam on the Central Valley project. Crowe is well known as a dam builder: his two latest jobs were Parker Dam, just completed, and before that, Boulder Dam, where he was in charge throughout the entire construction period for Six Companies, Inc.

Engineers to Expand Professional Work

American Society of Civil Engineers sets up a new committee on professional objectives

The social status and economic welfare of the engineer received considered attention at the Salt Lake convention of the American Society of Civil Engineers, July 20 to 23. First, the board of direction set up a new committee on professional objectives as an alternate to establishing a division on professional activities as was called for in a petition sent to the board in January 1937. Second, the annual address of the president, Henry E. Riggs, contained a close analysis of other than technical problems of the engineer and the profession and expressed the conclusion that the society should extend its activities to include all matters which have to do with the financial well-being of its members. The society should be looked to for leadership, he said, in all matters pertaining to the social and economic welfare of the engineer just as it is looked to with respect to his practice, ethics and scientific perfection

Finally, in the local sections conference, rating procedure and economic status of the young engineer were discussed.

Reports printed

Departing from custom, the board of direction received and ordered printed prior to approval reports on two controversial subjects. Discussion by members is thus to be stimulated. The subjects of the reports are national water policy and the proposed federal department of public works.

Some time ago a committee on water policy was set up to guide the board in any action that might be taken on bills in the last Congress relating to the subject. Since none of the bills became law it is now the intention to attempt to form principles and policies at a time when discussion can be free from the heat of political considerations.

Public works department

On the question of a federal public works department, the board a year ago went on record in support of such a department. Its committee on this subject is not now in favor of supporting such a proposal but recommends that the board give serious consideration to the endorsement of a proposal to establish a reviewing and coordinating agency.

The technical program for the general sessions was built around the topic of transportation; railways, highways, waterways and airways. Four divisions held meetings. On Thursday the highway and irrigation divisions held morning and afternoon sessions, while the sanitary engineering and surveying and mapping divisions restricted their meetings to single sessions. There were thus but three simultaneous sessions and these with non-conflicting interests. These sessions will be reported next week.

Excursions included an all-day trip to the nearby open-pit copper mines and mills and the flood control works at the Garfield smelter, protected by a mile-long barrier against flood-carried debris from a canyon above the works. Mud-rock flows and flood control works in Davis County, the Pine View Dam at Ogden, Echo Dam, and Mountain Dell Dam, a multiple arch structure, were visited by separate parties.

Professional objectives

The functions and objectives of the new committee on professional objectives are essentially those set forth in the petition for a division on professional activities. Some of them are as follows: To endeavor to facilitate the working together of those members who are particularly interested in the affairs and development of both salaried and employer engineers, providing an agency through which these members may express themselves more freely and effectively on professional matters. To give general consideration to legislation affecting the engineer. To give particular consideration to the economic and social status of the engineer and to national and social trends affecting it; together with consideration of all of the humanities of the engineering profession. To encourage wider employment of engineers in engineering and technical works and in the management and direction of engineering and technical works so as to increase public demand for engineers. The field secretary of the society, W. E. Jessup, is assigned to this work. E. R. Needles was named chairman of the committee.

Classification and pay

In the section conference C. E. Painter, Salt Lake, made a plea for a comprehensive and detailed classification of engineers, with a corresponding salary schedule, to be carried out by some governmental agency, preferably the Bureau of Labor Statistics, with the societies donating their service to see that the classification is drawn as skillfully and competently as possible. Such a rating, in his opinion, would (1) take care of the emergency growing out of the inclusion of engineers under the Wagner Act, (2) insure more adequate pay, (3) form the basis for strong, effective and uniform registration laws, (4) serve as a basis for a national employment service and (5) become the basis for a campaign of education as to the real nature of engineering, distinguishing engineering in the public mind from the non-professional technical trades.

Freeman scholarship

The board of direction announced the award of the Freeman traveling scholarship of $1,600 to Lieut. Douglas C. Davis, acting director of the U. S. Waterways Experiment Station, Vicksburg.

CIVIL ENGINEERS DISCUSS PROBLEMS

DIRECTORS of the American Society of Civil Engineers spent two busy days preceding the Salt Lake City Convention working on problems of the society. Here shown (seated, left to right) are R. C. Goudy, vice president; Daniel W. Mead, past president; Henry E. Riggs, president. R. K. Brown of the local convention committee stands back of Dr. Mead.

Chicago Filter Plant To Be Started

PWA makes grant and city issues bonds to begin $21,000,000 water treatment project

The Chicago City Council on July 20 authorized the sale of $6,700,000 in water certificates to provide the city's share of the cost of starting work on the South Side filtration plant. PWA has announced that it will make a grant of $5,415,750, 45 per cent of the cost of the project. The cost of completing the full South Side filtration plant will be about $21,000,000. The water certificates will be retired entirely from water revenues.

Meters included

The PWA project includes the installation of meters in the South District of Chicago.

The filtration plant, which has been sought for many years by Chicago citizens and for which a PWA application has been pending since 1933, will be built on filled land in Lake Michigan at the foot of 79th St. It will filter all the water used in the South District of Chicago and in the thirteen South side suburbs which buy city water—a population of about 1,700,000.

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Harza Named Engineer For Santee-Cooper Job

PWA Administrator Ickes has approved the award by the South Carolina Public Service Authority of a contract for engineering services on the Santee-Cooper project to the Harza Engineering Co. of Chicago. At the same time the administrator announced appointment of Kenneth W. Markwell as project engineer for PWA on the power and navigation job.

The Santee-Cooper project is being built by the South Carolina Public Service Authority with the aid of a PWA allotment of $10,500,000. The project has a total estimated cost of $37,500,000. It consists of a 6-mile long dam on the Santee River and a 2-mile long dam on the Cooper River, the latter flanked by 26 miles of dikes. Navigation locks will be installed at the Cooper Dam, and a combined navigation and diversion channel between the Santee and Cooper Rivers will parallel the old Santee Canal, providing direct navigation facilities connecting Charleston and Columbia, S. C. About 450,000,000 kw.-hr. of firm power and 250,000,000 kw.-hr. of secondary power will be generated at Cooper Dam.

Before his present appointment, Markwell was chief project engineer for PWA in the Tennessee Valley Authority and earlier had been state director for PWA in Tennessee. Before he came with the PWA in 1933, Markwell was consulting engineer to the Memphis Light & Water Commission.

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Drive Against Lobbying Continued by PWA

Acting further in his drive against employment of professional lobbyists by communities seeking grant allotments, PWA Administrator Ickes ordered all PWA employees to have no dealings with Glenn E. Miller. Miller is the lobbyist whose connection with a PWA application from Riverside, Calif. led to the suspension of the application. (*ENR*, July 21, 1938, p. 66.)

At the same time, final grant payment on one California project and any action on eight California allotment applications were suspended pending investigation of reports that Miller had been involved in the projects.

One of the latter projects, an application for PWA aid in construction of a waterworks at South Laguna, was restored to active status within a few days upon receipt of a telegram from the president of the South Coast County Water District asserting that although Miller had offered his services to the district, his offer had been refused.

PWA's Division of Investigation has also been ordered to look into a case of alleged lobbying at Newton Falls, Ohio. The case involves a contract made by the village authorizing payment to William M. McLain, a lawyer, of 5 per cent of the total cost of a $205,000 municipal power project for which PWA recently granted $92,250. McLain is counsel for the village of Newton Falls, and the 5 per cent fee was to be made for "extraordinary services" in addition to his regular duties.

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California Flood Control Not to Be WPA Job

All further flood control projects in the Southern California area will be built by contract or by the U. S. Engineers' own forces, the U. S. Engineer Office there has announced.

Projects now under way with WPA labor are being continued by transferring the men to the district payroll and supervision, but no more operations are to be handled as relief jobs. Hansen and Prado dams and Los Angeles River and other channel improvements will be built under contract, and some smaller jobs will be done by day labor.

Cost of Speeding Plans Approved by PWA

Extra architectural and engineering costs may be incurred to hasten construction

Additional expenses incurred by architects and engineers for the purpose of speeding up plans and specifications on PWA non-federal projects will be regarded as a proper item of project cost on which a grant will apply, Public Works Administrator Ickes has announced. Within certain limits, PWA will bear 45 per cent of the architect's or engineer's extra expenses. These additional expenses would include such items as hiring of additional help and incurring of overtime work.

Contracts for architectural and engineering services which include payment of a premium for speedy preparation of plans must be approved by the PWA regional director, and the extra payment must be based on a sliding scale ranging from an increase of 10 per cent of the base fee calculated on a construction cost of $250,000 or less to extra payment of 5 per cent of the base fee on a construction cost of over $1,250,000.

First money flows

Meanwhile, the first actual expenditure of funds under the new PWA program was announced with the granting of a request from Paris, Ark. for an advance of $30,000 on its grant of $90,000 for an addition to the local waterworks system. The advance will be used to defray preliminary expenses of getting the project under way.

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Milwaukee Pays $810,000 To Activated Sludge

The patent infringement judgment of $4,927,000 obtained by Activated Sludge, Inc. against the city of Milwaukee (*ENR*, Aug 5, 1937, p. 211) was settled by the city on July 23 for $818,000, ending a long court battle.

The award against the city was based on infringements of patents on the activated sludge process of sewage treatment held by Activated Sludge, Inc. The suit was brought in 1924 against Milwaukee and a number of other cities.

A similar claim against the city of Chicago, entered at the same time as the Milwaukee claim, is now being evaluated in federal district court, the U. S. Supreme Court having refused last October to accept an appeal from a circuit court of appeals ruling that the city had infringed activated sludge patents.

Lilienthal Denies Mismanaging Dams

He says Morgan misrepresented cost of Chickamauga in testifying before Congress

Because of the constant danger that the management will utilize reservoir capacity needed for flood control in order to make a better financial showing by selling more power, Arthur E. Morgan told the congressional committee investigating the Tennessee Valley Authority, many engineers doubt whether flood control and power can be safely combined in the same project. David E. Lilienthal, while not commenting directly on this statement, actually countered later when he told the committee that only one third of the available TVA power was now being used. He said the estimated peak demand for 1938 was 250,000 kw., as compared with an installation of 420,000 kw. at the present time, of which 355,000 kw. is prime.

Morgan surprised some committee members by insisting that high dams were the most economical even for flood control, resisting vigorous cross examination on this point and stating that each additional foot at the top provided an enormous increase in the total capacity of the reservoir, and utilized much cheaper land—hillsides as against fertile bottoms.

Morgan also criticized TVA for laying so much stress in its publicity on soil erosion in connection with flood control and navigation. Soil erosion prevention, he said, was an estimable work and should be done, but to give the country the idea that this was one of the chief factors in flood prevention was an inexcusable exaggeration. He called attention to pictures with captions that in his opinion were misleading, indicating that not only would the soil of the farmers be preserved, but disastrous floods prevented. To illustrate his point, Morgan said careful calculations had been made which showed it would take 4,000 years for the Norris reservoir to silt up.

Lilienthal attacked Morgan bitterly for misrepresentation to the House Appropriations Committee as to the cost of Chickamauga Dam. Morgan had accused Lilienthal of playing politics with a local election in Chattanooga, which town was very much interested in prompt spending on the Chickamauga site, a procedure Morgan favored. Lilienthal produced photostats of Morgan's testimony before the House Appropriations Committee that the cost of the dam would be about fifteen million.

At that time, Lilienthal said, army engineers had estimated the cost at nearer twenty million, while Morgan's engineers had discovered factors in the foundation situation which promised to increase the cost. Actually he said the dam had cost almost twice Morgan's estimate. He told of persuading Morgan to correct his testimony partially in a letter to Representative McReynolds, and said as a result of even this partial correction the Senate changed the plan and ordered Hiwassee Dam built first. Morgan had insisted that the Hiwassee Dam was charged solely to flood control and navigation.

Lilienthal, in defending the length of time it had taken to work out the allocations of cost as between flood control, navigation and power, cited obstruction by Morgan. He said Morgan had insisted that a committee of expert engineers from outside be called in. This followed several conflicts between the engineers under Morgan and the valuation committee set up by Lilienthal. Morgan's plea for outside engineers was rejected.

PERSONAL

HARRY MARKHAM MARSH, engineer, has been made president of W. J. Westaway Co., Ltd., engineers and contractors of Hamilton, Ont.

FRED E. FOSS, 76, head of the department of civil engineering at Cooper Union in New York City, will be retired at his own request at the end of this academic year. Before joining the staff of Cooper Union 29 years ago, Professor Foss was head of the civil engineering department at Pennsylvania State College for 14 years, and at Carnegie Institute of Technology for two years. He began his teaching career as instructor in the Massachusetts Institute of Technology in 1891.

RAY C. BRUMFIELD, assistant professor of civil engineering at Cooper Union, has been appointed acting head of his department for the coming school year.

HAROLD O. CHURCH became city engineer of Zanesville, Ohio, last month.

OSCAR F. SCHILLING, Shelby County, Ohio, resident highway engineer for five years, has been promoted to assistant engineer in charge of construction in District No. 7.

F. F. HAVEY has been promoted from assistant to head of the Indiana state highway commission's testing laboratory.

GEORGE W. RABEY has been appointed highway engineer of Edmunds County, S. D., succeeding R. L. Holmes, resigned.

Central Nebraska Project Approved by FTC

The power project under construction on the North Platte River by the Central Nebraska Public Power and Irrigation District is "desirable and justified in the public interest . . . for the use and benefit of interstate commerce on the . . . Missouri and Mississippi Rivers," it was stated by the Federal Power Commission in a finding handed down July 23. This finding by the commission makes it possible for the district to obtain needed land and property by condemnation proceedings in the federal court.

Operation of the power project, the commission found, "will result in the storage of flood waters and the release of impounded water at a gradual rate, thus reducing flood flows in the North Platte and Platte Rivers . . . and increasing low water flows. . .

"The operation of the project will result in a reduction of the discharge of sediment from the Platte River into the Missouri . . ."

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Baltimore City Engineer Dies at Forty-Eight

Bernard L. Crozier, chief engineer of Baltimore and holder for many years of responsible engineering posts with the city, died July 23 at the age of 48 after an illness of about two weeks.

After three years study at Alabama Polytechnic Institute, Crozier became a rodman in 1907 for the Baltimore & Ohio, held a similar position for United Railways and Electric Co. of Baltimore, and was for three years an inspector for the Maryland State Roads Commission. Meanwhile he studied at Baltimore Law School, being admitted to the bar in 1911. He never, however, practiced law.

Crozier entered the service of the city of Baltimore in 1912 as an assistant engineer on the Paving Commission. With the exception of a year's work for Bartlett Hayward Co., he served with the Paving Commission until 1923, leaving with the rank of office engineer in charge. He spent two years as highway engineer of the city and in 1925 was made chief engineer and head of the Department of Public Works of the city.

A political shake-up in the Baltimore engineering offices resulted in Crozier's dismissal in 1927, at which time he opened offices in Baltimore to practice consulting engineering. Two years later he was made chief engineer of the Metropolitan District of Baltimore.

Crozier resigned the county post in 1931 to resume his position as chief engineer of Baltimore, which he held until his death.

Two Dams Fail In Heavy Rain

Small Connecticut dams go out, washing out culvert—Pennsylvania waterworks flooded

Chief damage to engineering structures from the week-long heavy rainfall along the North Atlantic Coast was the failure of two small reservoir dams owned by the Guilford-Chester Water Co. of Clinton, Conn. A 12-ft. high masonry dam storing about 30,000,000 gal. of water and an 18-ft. high earth dam, with core wall, storing about 130,000,000 gal. failed July 23 when a cloudburst followed an accumulation of about 10 in. of rainfall.

Outflow from the reservoir took out a 10x10-ft. culvert under high fill on Route 80. Fill was washed away for 150 ft. to a depth of 40 ft., destroying the culvert wing walls and undermining the box culvert.

Loss of the dam seriously curtailed water supplies in Madison, Clinton, Guilford, Westbrook, and Old Saybrook. Since 6 ft. of water was left behind the large dam, however, an absolute failure of the water supply was prevented.

Emergency rationing of water was also necessary in Ambler, Pa., Philadelphia suburb, when high water submerged the borough pumping plant.

Flooding of major highways, including the Bronx River Parkway in New York City, disrupted transportation in the New York City metropolitan area. In New England, some local roads were washed out and there was some disruption of railway service.

OBITUARY

LEWIS A. BURNS, 59, secretary of the Watertown, N. Y., consrtuction and engineering firm of Burns Bros. and Haley, died there July 14. His firm had built numerous power plants in northern New York. A graduate in civil engineering of the University of Wisconsin, Burns was an engineer in the New York State highway department for nine years before going into business with his brother.

EDWARD L. INGRAM, who retired in 1932 from the position as professor of railroad engineering and geodesy at the University of Pennsylvania which he had held since 1911, died in Grand View, N. Y., July 25, at the age of 75. Ingram graduated in civil engineering from Columbia University in 1885, worked as an assistant engineer for the War Department for six years and was then engaged for four years surveying the boundary between the United States and Mexico for the state department. After four years at the New York Navy Yard in Brooklyn, he joined the faculty at Pennsylvania in 1906 as an assistant professor of civil engineering.

FLAVIUS J. GEORGE, 65, Seattle civil engineer, died there July 21. A graduate of the University of Washington, George was division engineer for the Grand Trunk Pacific in Canada and later worked for the Pioneer Sand & Gravel Co. and the Sunset Oil Co., retiring on account of illness about two years ago.

JAMES B. BLAKE, who retired in 1932 as superintendent of the water bureau of the Detroit Fire Department, died July 16, at the age of 80. Blake had been connected with the fire department since 1901, became assistant superintendent of the water bureau in 1916, and superintendent in 1929.

HAROLD B. BREARE, town engineer of Marblehead, Mass. since 1922, and previously division engineer for the Boston & Maine and the New Haven, died at Beverly, July 24, aged 66.

EDWIN R. THOMAS, treasurer and manager of the engineering and construction firm of Locke and Thomas, New Bedford, Mass., died in South Dartmouth, Mass. July 4 at the age of 51. Thomas served as a captain of engineers during the World War. He was a graduate of Cornell University.

HERMAN E. VANTHIJN, Los Angeles civil engineer, died of thirst in the California desert July 18 or 19, when his car broke down during a trip to examine some mining property near Owl Spring. VanThijn was a graduate of Delft University in The Netherlands. He had practiced in Los Angeles about two years, having previously practiced in New York City for eight years.

R. F. MCLAUGHLIN, 52, associate director of purchases for the TVA, was killed July 21 in an automobile accident near Wheeler, Ala.

• • •

Wooden Trestle Bridge Burned in Montana

An untreated pile and timber trestle on the Chicago, Milwaukee, St. Paul & Pacific line near Mildred, Mont. was destroyed by fire the morning of July 21. The trestle was a six span structure 95 ft. long and 23 ft. high, built in 1926.

Railway service, which was interrupted by the fire, was resumed on the morning of the 22nd. The cause of the fire has not been definitely determined, according to chief engineer, W. E. Pewfield of the C.M.St.P.&P.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

IMPORTANCE is attached in Washington to the meeting, which begins Aug. 1, of the governors and engineers of the states of the Colorado river basin. A plan for the progressive development of the river will be evolved, it is expected. For six years the Bureau of Reclamation has been engaged in an inventory of the land and water resources of the basin. The point now has been reached where intensive study must be made of individual projects.

WATER CONSERVATION in the northern portion of the great plains area will be discussed at a meeting in Omaha July 30. While $5,000,000 of relief money was earmarked for this purpose, the undertaking was complicated, if not made impossible, by the action of Congress in providing that not more than $50,000 may be spent on any one project. The need is for dams and pumping plants so that water may be distributed from the Missouri River. The $50,000 limitation rules out that method of handling the problem.

• • •

Big Rental Housing Job Planned on Coast

One of the largest rental housing projects ever undertaken by private capital is to be put under construction in Los Angeles before Sept. 1 and is expected to be completed within ten months. Contract for construction of the project has been awarded by D. Herbert Hostetter Estate to Lindgren & Swinnerton of Los Angeles, on a bid of about $3,250,000.

The project will provide 1,102 dwelling units, intended to be rented to white collar tenants in the middle bracket rent group. Located on a 72-acre tract in the east side of the city, it is expected to cost about $6,000,000 to complete.

The plans call for 142 two-story buildings, following nine basic designs but incorporating about 100 exterior variations. Construction will be of frame and stucco throughout, with the bracing for earthquake resistance. The buildings will be fire-resistant with addition of considerable extra cross gypsum lath walls and extra heavy plaster.

The present contract does not include landscaping, or construction of recreational facilities, streets, and commercial buildings. These are to be built later as required.

ENGINEERING NEWS-RECORD

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Editorial Offices at 330 West 42nd Street, New York

JULY 28, 1938

ACCOUNTING PRACTICES of the highest type are called for in maintenance activities conducted by state highway departments. The items of work that have to be recorded are so many that the mere volume of figures is imposing and highly complex. But maintenance accounting involves a much greater task than accurate bookkeeping; it must show costs of comparable items under different conditions over a wide range of service requirements and for many types of road structure. This calls for high qualities of selectivity and organization. In stressing these factors the article that the chief accountant of the Illinois department of highways contributes to a following page is important. The mechanics of the system are the most modern in accounting practice but the fact is not overlooked that they are merely the means of arriving at accurate measures of road service that the engineer can apply in future design and construction. This is the service that maintenance accounting commonly fails to give. Its need should be more widely appreciated.

Safe Water for Chicago

LEADER in sewage disposal but laggard in water treatment, Chicago is at long last initiating work for the installation of filtration facilities. Backed with a grant of over $5,000,000 from PWA, the city has approved the issuance of almost $7,000,000 of water certificates and thus will finance the first stage of a project that is estimated to cost $21,000,000 upon completion. Setting the stage for this occasion are preparations that extend back for many years, years during which bickering and politics held sway while public health was menaced. Despite the application of chlorine, the raw water supplied to Chicago's citizens could never be regarded as completely acceptable in regard to quality. It is fitting, therefore, to pay tribute to those who have labored so long and earnestly to bring the day when the city could be assured of a safe and dependable water supply. The construction of a filter plant means, too, that the city will install meters. This will be an effective check on a present abnormal consumption demand, and will extend into the future the usefulness of its water tunnels and distribution system now being taxed to capacity. Last of the major lake cities to filter its water, Chicago should lose no time in bringing the job to completion.

Hazards of Tunneling

AN EPIDEMIC of tunneling disasters during the past three weeks calls attention to the inherent hazard of this class of construction work. First came the fire in high-pressure air in the north Manhattan heading of the Queens Midtown tunnel at New York. This heading is still closed because of concern for the adjacent south heading, where filled ground and riprap along the western side of the East River channel are giving trouble. The latter heading was nearly lost a few days ago from a bad blow at the face which partly flooded the tube, but was saved after a 36-hr. heroic fight. Another air tunnel accident occurred at Memphis when an air lock failed, killing one man and delaying progress for a week. Last Wednesday's tragedy at Baltimore in which ten lives were snuffed out by an unexplained premature explosion was the climax of the current series of underground mishaps. Laws and regulations have done much to promote safety in tunneling, but one slip or one moment of relaxation in eternal precaution means trouble. Tunneling deals with Titanic forces. Disaster is waiting to strike at any minute.

The Augean Stable

TESTIMONY in the TVA inquiry last week revealed the Tennessee Valley undertaking as an Augean stable of public administration. It showed confusion, conflict and trickery, and disorganization of authority in the board. The much-discussed "yardstick" power rates announced soon after the authority came into existence were shown to be arbitrary figures representing one man's views, fixed long before costs were known. Another outstanding feature of the inquiry was the attempt of lawyers, including even the counsel to the Congressional committee, to obstruct access of witnesses to necessary records, an action which necessarily tended to conceal facts. In court proceedings, we believe, such action is considered highly immoral, but in Congressional investigations a lighter professional conscience may prevail. The proceedings to date make it more important than ever that the inquiry probe deeply into TVA management. Intimations of attempts by agents of the TVA board to procure biased engineering reports strengthen the argument—though, we are glad to say, there is not even a suggestion that the engineering staff yielded to such demands. The country cannot afford to tolerate sharp practices, concealment and distortion of fact in a great enterprise of planning, construction and development. The charges and counter

charges now being exchanged at Knoxville need to be fully explored to determine where responsibility for this state of affairs lies.

An Essential Cost

THAT THE WORK of engineers and architects in planning construction projects is an essential and important part of the undertaking is now formally recognized by the PWA. Extra fees are to be allowed designers of PWA projects to permit them to speed up their design work. This is a far cry from the early days of the PWA when that agency appeared to look upon preliminary engineering and architectural studies as superfluous, something for which it would not authorize advance expenditures and which should not be included in the cost when figuring grants. The change of view is welcome. It shows that those in the PWA who originally were not familiar with the need for expenditures of considerable magnitudes for preliminary work now appreciate its value as a means for speeding actual start of construction.

Permanent Track

TRACK of greater permanence than that built according to current methods is an ideal that railroad maintenance engineers have long sought to attain. Normal maintenance charges form so large a part of the current expense budget as to make it obvious that considerable capital can be invested in structures that reduce maintenance.

Described in this issue is a track structure with which the Missouri Pacific has been experimenting for about two years. It is not permanent track as that term is generally accepted among railroad men, yet it may be that because of its provision for a considerable amount of longitudinal flexibility and resilience it is a better approach to the problem than that found in the permanent track sections installed about ten years ago on the Pere Marquette.

The Missouri Pacific installation is designed to minimize the effect of a particularly bad subgrade condition. It consists of reinforced-concrete slabs laid between the subgrade and the ballast, at a cost of about $12,000 a mile. On the Pere Marquette a slab over the subgrade carries longitudinal concrete girders without ballast or ties, the rail being clipped to the girder. These sections cost about $50,000.

Absence of the resilience provided by ballast and wood ties makes for noisy and hard riding track. Years ago, railroad engineers learned that there must be a deep ballast bed through rock cuts if rapid battering of rails is to be avoided. The pounding of wheels at low joints is amplified by the unyielding base. Similarly, where track is carried directly on a slab or girder any inequalities of surface are more serious in their effect on rail and riding qualities than on ordinary track. Under these circumstances it seems probable that efforts to eliminate ties and ballast entirely may be carrying the permanent-track idea too far.

With the wider use of heavier rails, treated ties and stone or screened-gravel ballast that is now common on American railroads replacement costs have been progressively reduced, until there is question as to whether such track laid on a concrete slab, as is done in the Missouri Pacific test section, is less permanent than track on which the rail is laid directly on a combined slab and girder. More permanence doubtless is a desirable objective, but absolute permanence may be a will-o'-the-wisp that would be disappointing could it be obtained.

No More Self-Protection?

DEDICATION of the Muskingum River flood-protection works ten days ago calls to mind the great flood of 1913, in which the Muskingum area suffered almost as seriously as the Miami Valley to the west.

After the flood the people of the Miami planned and built their own flood-protection works, and by paying for them out of their own pockets in partial return for the benefits received, they showed that self-protection was possible. The Muskingum Valley was unable to make similar progress, though there also it was known that the benefits would far exceed the cost of protection; its work could begin only five years ago, when federal money was offered. The district contributed to the cost by buying the reservoir lands, but even this expenditure has been reimbursed by recent action of Congress.

Now, with the establishment of the policy that the federal government will pay all the costs of flood work, the system under which the Miami River communities provided their own protection comes to an end. The new system has yet to show its merits. It may accelerate or may retard flood protection; the job may be done better or worse.

But in either event, it is unfortunate that local participation in the financing and construction of flood-control projects is to be abandoned. Far better would be an arrangement similar to that employed by the federal government in aiding highway construction where states match the federal funds and retain the responsibility for design and construction. It may be that dollar-for-dollar matching would not be possible in any case, but seldom should the local community or the state be freed from having to share in the cost and bear the responsibility for planning and execution.

PICTURES IN THE NEWS

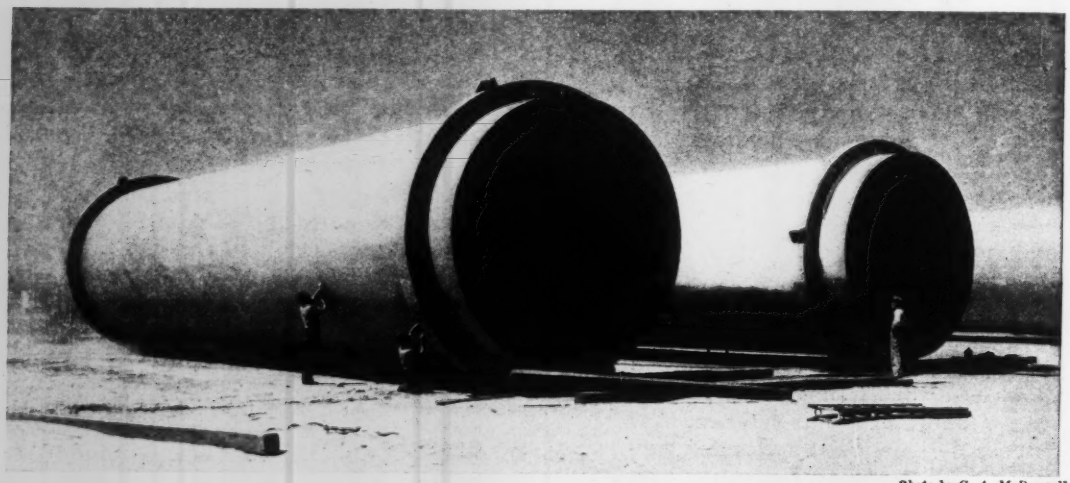
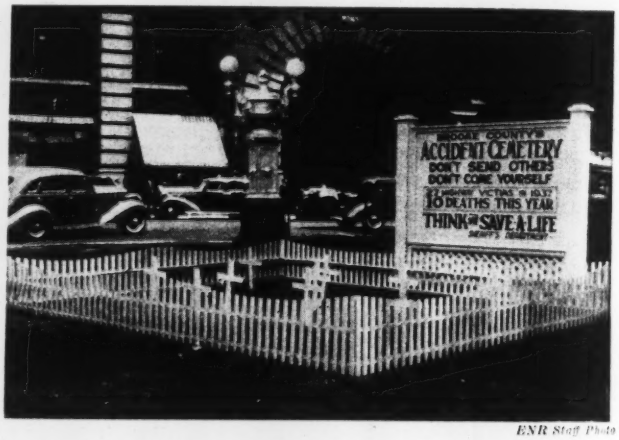


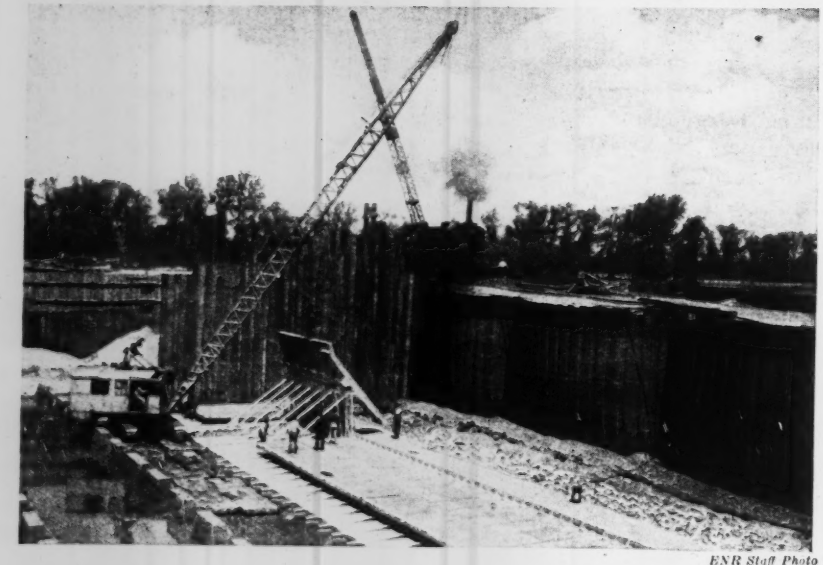
Photo by C. A. McDougall

CLEANING PIPE FOR THE ALL-AMERICAN CANAL. *Welding splatter is being chipped off these two 15½-ft. diam. siphon pipes following sand blasting. They will be part of the crossing of the New River, 1½ mi. west of Calexico, Cal.*



ENR Staff Photo

HIGHWAY SAFETY AT BINGHAMTON. *When a traffic fatality occurs in Broome County, N. Y., a white cross is erected in this plot at the county seat town.*



ENR Staff Photo

CHANOINE WICKETS, *a popular type of movable dam 50 years ago, but seldom used in the past two decades, have been revived on the new Peoria Dam on the Illinois River at Whitehouse, Ill., being built by Warner Const. Co., of Chicago, for the U. S. Engineer Dept. This view shows the wicket sections, 16 ft. high, being dropped preparatory to flooding of the first of two sections of a cofferdam.*

FIG. 1. SLIDING THE SLABS UNDER THE TIES

Slabs Support Railroad Track

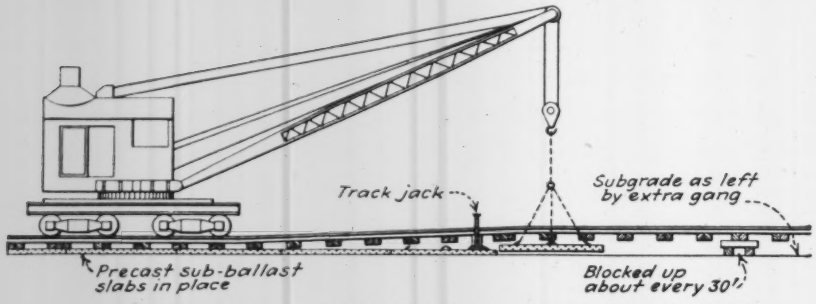
Missouri Pacific uses sub-ballast slabs to carry track across soft ground that had made maintenance costs abnormally high

MAINTENANCE costs on track across soft ground have been materially reduced on a test section of Missouri Pacific track through the installation of concrete slabs between the ballast and the soft subgrade. Such an installation 2,600 ft. long was made in November, 1936, at Jones Ridge, Ill. This section proved so successful that a 2,025-ft. section was added in May of this year. Maintenance costs of less than $60 in 16 months on the 1936 section were largely responsible for the decision to add more slabs this year.

The Jones Ridge location is a section of heavy freight track built on a fill in Mississippi River bottomland composed mostly of gumbo and clay. Prior to the use of slab support, costly day to day maintenance had been necessary to keep the track in line and surface for heavy duty. Several expedients were sought, culminating in the development of the concrete sub-ballast slab and the installation of the first 2,600 ft. over the most troublesome part of the roadbed.

In theory, the sub-ballast slab was developed to spread the load on the track over a greater portion of the roadbed, and practice has proved that it does. Reinforcement and slab thickness provide a resisting moment about equal to that of first class wooden ties. By applying ballast and ties above the slab, the load distributing ability is increased. More important is the fact that the slab provides a "blanket" on the subgrade, conducting water away from the track and preventing the pumping action of the ties.

Slabs developed for the first big installation were 12 ft. wide and 10 ft. long. Thickness at the center was 6½ in., sloping to 5½ in. at the edges to assure drainage away from the center line of the track. Reinforcement consisted of ½-in. bars on 12-in. centers top and bottom longitudinally, and on 6-in. centers on bottom and 12-in. centers on top transversely. The slabs employed on this year's project are similar in design to those in the first installation



The crane rides on unballasted track supported on the placed slabs.

Fig. 3. Slabs in place ready for ballast.

except that they are 9 ft. long, making them easier to transport on flat cars. Each slab contained 2 cu.yd. of concrete and 370 lb. of reinforcing.

All the slabs were made by the Missouri Pacific at Little Rock, Ark. They were cast in gang molds into which prefabricated reinforcement was set as units. The concrete, placed by vibration, was essentially a 1:2:3½ mix with 6 gal. of water per sack of cement. After thorough curing under wet burlap the slabs were stacked until required on the job. They were then shipped to location and unloaded beside the track.

Slab installation

Installation of the slabs required a 25-ton capacity crane and a crew of one crane man, fireman, two slab men, torch man to burn off handling hooks, and a foreman.

Working ahead of the crane was an extra gang of 26 men who shoveled out ballast to a depth ranging between 10 and 18 in. below base of rail and blocked up track every 30 ft., leaving the ties hanging to the rails. Using a low boom, the crane set slabs three slab lengths ahead of itself, permitting the torch man to burn off lifting loops on the slab before moving forward.

Each slab was lifted from the slope of the embankment and dragged under the blocked-up track until the cable of the lifting bridle fouled the outside of the rail. The hooks were then released, the cable moved inside of the rail and the hooks reinserted in the loops, permitting the crane to jockey the slab into position. The lifting loops, located 6 in. off the center line of the slabs, permitted the forward end of the slab to raise as it progressed sideways under the track and to allow the outside edge to drag.

While a slab was being moved into position the track was held up by high-lift jacks resting on the slab just set and on blocking about one rail length ahead. As each forward slab was set the jack release triggers were sprung dropping the track onto the slab just placed. The jacks were then moved forward one slab length and the process repeated. Two section men manipulated the jacks and the blocking, keeping ahead of the slab setting a constant distance.

No ballast was put on the slabs until the crane had cleared them in its forward progress. Thus, for a time, the ties under the rails carrying the crane rested directly on the slabs except for a thin wood strip under the ends of the ties to make up for the slope of the top surface of the slabs. No slab was broken or damaged even under this unusual loading. Later, a part of the extra gang placed 8 in. of new chats ballast on the slabs and lined and surfaced the track to desired grade.

The time required to pick up the slabs from the embankment slope and put them into place under the track averaged about 2 min. per slab, but some were clocked at 1 min. 38 sec. This speed was due to improved technique gained through the experience in installing slabs in 1936. At that time, 80 slabs (800 ft. of track) were set in a 5½-hour working day, while in 1938, 101 slabs (909 ft.) were set in a day of 3 hr. 50 min. of actual work. The highest speed attained for any considerable period was 51 slabs in 1 hr. 45 min. This included all operations involved—cribbing out between ties, digging down to predetermined profile of the bottom of slabs, jacking and blocking up the track, bunching ties and setting of the slabs.

The cost of the second installation compares favorably with the first, although increases in cost of labor and material raised the cost of manufacturing the slabs somewhat. The extra gang in the second case, however, numbered 26 as compared to 36 in the previous installation when total cost of installation was $4.11 per track foot exclusive of transportation charges.

Direction

The work on both major installations was carried on under the direction of A. A. Miller, engineer maintenance of way, Missouri Pacific Ry. Design of the slabs was worked out by F. E. Bates, bridge engineer. Slabs were manufactured under the direction of J. R. Showalter, assistant engineer; P. P. Wagner, division engineer, was responsible for the installation work.

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Simplified Practice For Concrete Blocks Revised

A REVISION of the simplified practice recommendation on concrete building units will become effective Aug. 1, according to an announcement of the Division of Simplified Practice of the National Bureau of Standards. The revised recommendation will be known as R-32-38, whereas the previous schedule was R-32-32.

The present revision adds four 11¾-in. units to the schedule of recommended sizes, bringing the total number to 21.

Copies of the recommendation can be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington.

Measuring Volatile Bitumen

R. E. BOLLEN

Assistant Testing Engineer, Nebraska Department of Roads and Irrigation, Lincoln, Neb.

A test to determine how much volatile bitumen is removed in manipulating and aerating bituminous road surfacing mixtures

BITUMINOUS MIXTURES, in which cutback asphalt is used, often must be manipulated to some extent after the particules are coated in order to develop a suitable stability. This is particularly true in mixtures containing smooth rounded particles of aggregates. The period during which a portion of the total volatile bitumen is volatilized is often termed the aeration period and the percentage of the total volatile bitumen which volatizes is termed the per cent aeration. The aeration test described has been devised to determine the percentage of the total volatile bitumen which is removed during manipulation and aeration of bituminous mixtures.

Description of test

The apparatus consists of a 5x7-in. metal still or a one-liter glass flask similar to those specified in the A.S.T.M. D 95-30 test for water in bituminous materials and a graduated glass trap and a water condenser similar to those specified in A.S.T.M. D322-35 test for dilution of crankcase oils.

A 500 gram sample of the bituminous mixture, about 350 c.c. of water, and 3 grams of Na_2CO_3 are added to the flask or still and are shaken for about 1 min. The Na_2CO_3 added to the water and the shaking of the prepared sample tend to prevent sticking of the bituminous mixture to the bottom of the flask. The Na_2CO_3 also promotes stripping of the bitumen from the aggregate.

The apparatus is assembled as shown and the trap filled with water. Heat is applied to the still or flask so that refluxing starts within 5 to 10 min. after the heat is applied. The distillation is then regulated so that from 85 to 95 drops of water and diluent fall from the condenser tip each minute. The distillation is continued for three hours from the time the first drop falls from the condenser tip.

The diluent in the trap is allowed to settle and cool for at least 15 min. before the volume of diluent recovered is read. This reading is converted into per cent aeration by means of one of two formulas, the choice of which is determined by the factors which are known.

Computing per cent aeration

When the original per cent bitumen P_o used in the bituminous mixture, the specific gravity g of the cutback asphalt and percentage distilled to 680 deg. F. by the A.S.T.M. D902-36 distillation test in the cutback asphalt are known, the following formula is used to compute A, the per cent aeration.

$$A = 100 \frac{\frac{500\,P_o\,D_d\,K}{g} - D_a}{\frac{500\,P_o\,D_d\,K}{g}}$$

When the per cent of cutback asphalt P_a in the bituminous mixture is determined and the specfic gravity g and the percentage distilled to 680 deg. F. in the cutback asphalt are known the following formula is used to compute per cent aeration.

$$A = \frac{100 - \frac{2000\,D_a\,g}{D_d\,P_a\,K}}{1 - \frac{D_a\,g}{5P_a\,K}}$$

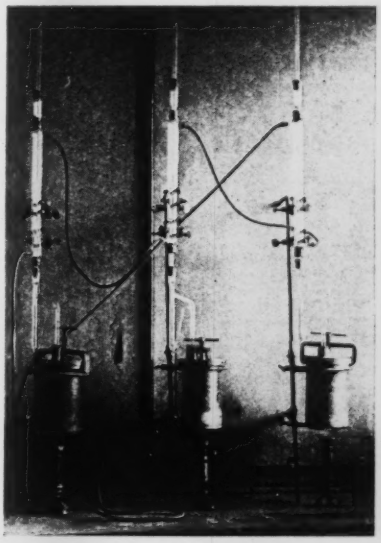
The symbols used in the two formulas are defined as follows:

K = per cent of the total volume of cutback asphalt recovered in the aeration test on a freshly mixed sample of the bituminous mixture divided by per cent by volume distilled to 680 deg. F. in the A.S.T.M. distillation test.

D_d = percentage by volume distilled to 680 deg. F. in the A.S.T.M. D402-36 distillation test.

D_a = cubic centimeters of volatile recovered in the aeration test.

P_o = original percentage by weight of cutback asphalt in the bituminous mixture.



Three-unit setup of apparatus for aeration tests of bituminous mixtures.

P_a = actual percentage of cutback asphalt in the mixture as determined by the extraction test.

Need of aeration

Bituminous mixtures containing aggregates of irregular shaped particles have a high stability due to the aggregate, and the consistency of the asphaltic binder has a minimum effect on the stability of the mixture. In bituminous mixtures containing smooth rounded particles similar to river sands and gravel, beach sand and blow sand the aggregate has a comparatively low stability and the consistency of the asphaltic binder is of considerable importance if the bitumen content is the optimum or above. It is necessary to aerate this type of bituminous mixture to remove a part of the volatile bitumen in order to develop a satisfactory stability of the mixture prior to laying it as a surfacing material. Aeration is not necessary from a standpoint of stability in any bituminous mixture that is deficient in bitumen.

The per cent aeration required in

any particular mixture must be established by actual service conditions, design and laboratory tests. The Nebraska road department requires 50 per cent aeration in dense-graded bituminous mixtures, containing MC cutback asphalts of 100-200 penetration base asphalt under normal conditions. It is safe to aerate these mixtures as much as 70 per cent in warm weather and about 40 per cent in cooler weather. These limits have been established through consideration of satisfactory stability, a smooth finished surface and economy of aeration and should not be used for any other mixture without proper investigation.

The aeration test described was developed in the highway testing laboratory of the Nebraska Department of Roads and Irrigation.

Timber Seawall and Bulkheads

Splined 10 x 18-in. timbers driven as sheetpiles serve successfully in breakwater and retaining-wall at Everett, Wash.

BULKHEADS and even a seawall of creosoted timber built by the Weyerhaeuser Timber Co. at Everett, Wash., in 1935 and 1936, are performing their functions so well that the owners expect the structures to have a life of 40 to 50 years. The simple designs used, illustrated in the accompanying drawings, were developed by modification of earlier types and are believed to have superior durability. About 4,300 lin. ft. of the timber bulkheads is in use.

At the site of mill *A* a bulkhead 2,700 ft. long was built to retain hydraulic fill and at the same time to protect it on three sides from tidal erosion. The fill, 28 ft. high in places, required substantial protection from wave action because the location is exposed to the battering of storms that sweep across 20 miles of open water in Puget Sound.

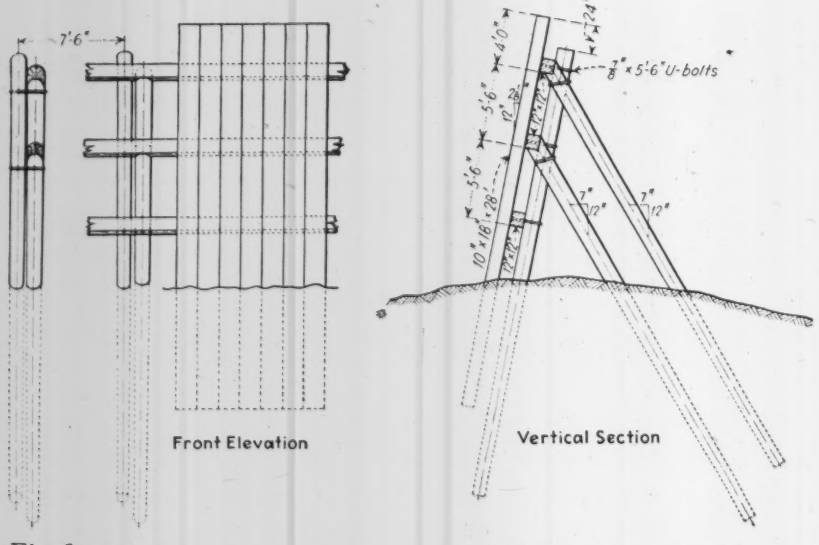


Fig. 1. The timber seawall built to protect a mill storage pond from wave action.

An essential element in the wall face is timber sheetpiling 18 in. wide, varying in thickness from 8 to 14 in. according to the height of the fill to be supported. These piling timbers, first surfaced, were grooved for 3x5-in. splines; timbers and splines were incised and given a 12-lb. treatment of creosote oil. The sheetpiling was driven against creosoted wales temporarily held in position by creosoted Douglas fir piling on the water side of the bulkhead.

Anchorage against the thrust of the fill is provided by steel tension rods. One end of each rod extends through the sheetpiling and the top wale, while the other end is secured to what may be considered, structurally, as a row of three-pile tripods driven back of the bulkhead (that is, within the area to be filled) and provided with loading platforms to make the weight of the fill and surcharge effective in resisting the overturning moment.

All sheetpiles were driven with a 6,000-lb. steam hammer to the final top elevation to eliminate trimming, so that the tops would be protected by the treatment. As the waters of Puget Sound here are infested with teredo it was thought advisable to creosote also the lower wales and the temporary supporting piles to avoid having wood adjacent to the bulkheads in which the borers might find lodgment. The company's experience with the use of creosoted piling and timbers in an adjacent wharf indicated that untreated wood would be completely destroyed in three to four years, while the life of the creosoted bulkhead may be expected to exceed 40 or 50 years.

The anchorage tripods and loading platforms are of untreated timber, as these members are protected against marine borers by the hydraulic fill and against decay by being below the line of permanent saturation.

Seawall construction

Construction somewhat similar to that just described was used in a timber seawall to protect a mill storage pond adjoining the bulkhead from the action of storm waves. This seawall consists of three sets of creosoted wales on a line of sheetpiling supported by diagonal pile braces

behind the two upper wales. The face of the seawall is 10x18-in. splined creosoted Douglas fir sheet-piling; the assembly of the structure is shown in Fig. 1.

For six months after completion of this seawall all fastenings were tightened at intervals for the purpose of following up shrinkage of the timbers. During the two years that have elapsed since its completion there have been several severe storms but the structure shows no signs of distress. As in the case of the bulkhead already mentioned, the owners expect the seawall to have a life of not less than 40 or 50 years.

A shorter bulkhead, some 1,600 ft. long, has been built by the same company to afford protection from flood waters of the Snohomish River and to support a hydraulic fill at the site of mill *B*. Construction of this wall is similar to that built for mill *A*, illustrated in Fig. 2.

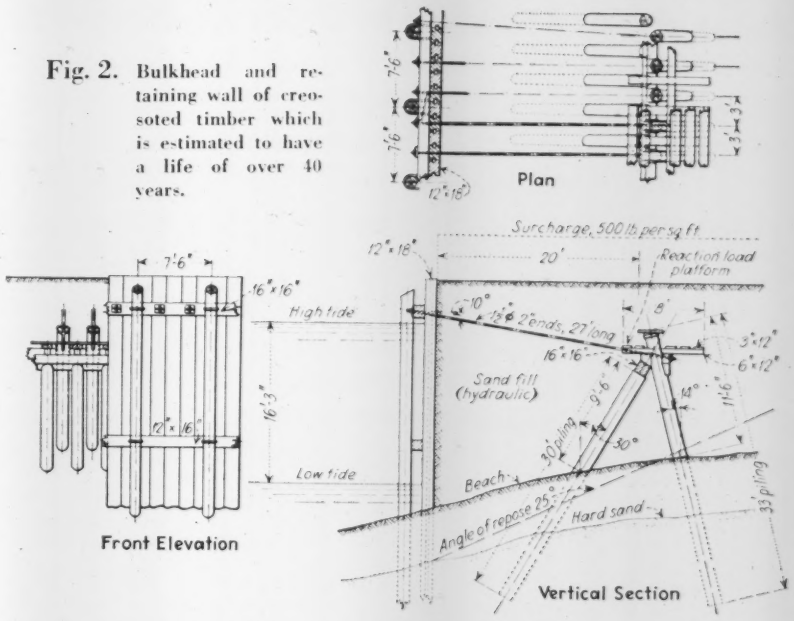


Fig. 2. Bulkhead and retaining wall of creosoted timber which is estimated to have a life of over 40 years.

To protect the tieback rods and other iron fastenings from the corrosive action of seawater all exposed metal was coated with a heavy asphalt. In the case of the tieback rods, after being so coated they were wrapped with spirally wound burlap and given another asphaltic coating.

An Insulated Water Meter Connection

Complaints of cloudy tap water made by a few consumers on the Los Angeles water system have arisen, it is believed, from the interaction of zinc (from the galvanized coating on the consumer's pipe) with carbonates and dissolved oxygen in the water, resulting in the formation of zinc salts. The rate at which these salts are formed is greatly increased if an electric current passes through the water as the result of cell action between two dissimilar metals in physical contact. Such a cell of considerable capacity can be formed by the copper service tubing, used on the Los Angeles water system to connect water main with meter and the galvanized iron or steel pipe used by the consumer.

It was found that if the two pipe systems are separated electrically from each other by means of an insulating sleeve, and if the potentials existing between them internally (due to the water) and externally (due to the soil) are practically equal, there will be very little if any current-flow through the water from metal to metal and the formation of zinc salts will be reduced to a minimum.

The water bureau accordingly developed a meter connection containing a sleeve or tailpiece that entirely insulates the two sides of the coupling. This connection, which is placed at the outlet side of the meter, is made in two sections; one screws on the meter's spud and the other slips over the consumer's pipe and is thoroughly insulated therefrom by a piece of hard vulcanized rubber tube 1 in. long and 3/16 in. thick. When the connection is to be made, a semi-hard rubber ring is first slipped over the consumer's pipe and the two sections are then screwed together. As the pipe ends approach, the semi-hard rubber ring is squeezed tightly around and against the consumer's pipe, making the joint watertight.

When removing or changing a meter where such a fitting has been installed it will be necessary to slide the insulated section and the semi-hard rubber ring along the consumer's pipe. Hence the pipe surface should be smooth and round and the galvanizing should be of lasting quality. To facilitate this the water department plans to select galvanized iron pipe that meets these requirements and cut it into pieces about 6 in. long. These pieces will be threaded on one end and equipped with a galvanized iron pipe socket. Thus the pipe wrench can be placed on the socket to avoid marring the galvanizing on the nipple when making connection to the consumer's pipe.

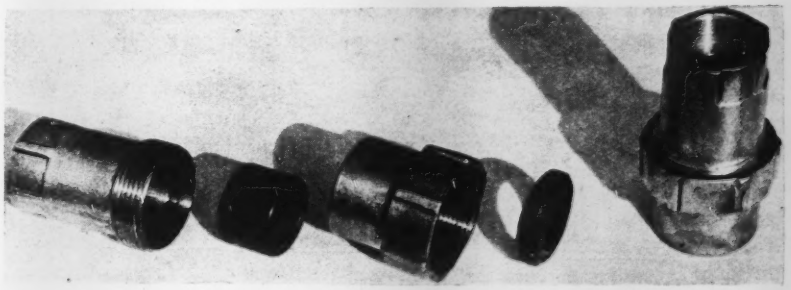


Fig. 1. The four parts of an insulating meter connection (left) before and (right) after assembly.

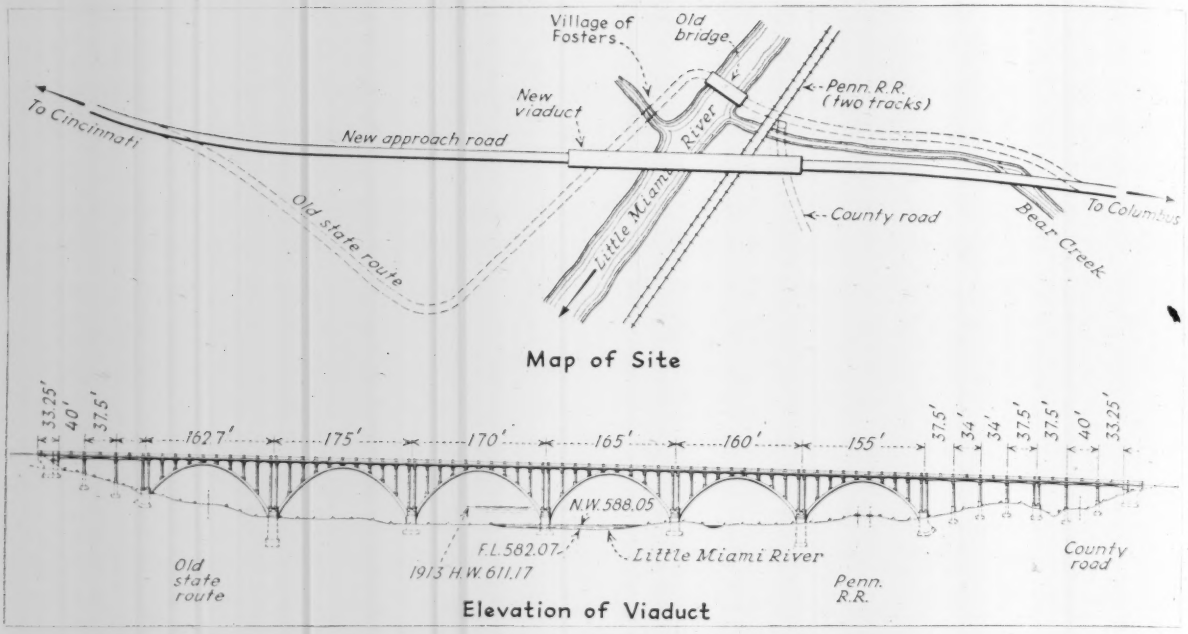


FIG. 1. A DANGEROUS ROAD WILL BE ELIMINATED BY THIS HIGH-LEVEL ARCH VIADUCT IN OHIO

High Level Bridge Corrects Bad Alignment

Viaduct of concrete arch spans over Little Miami River at Fosters Crossing eliminates dangerous railroad crossing and replaces bad section of Ohio trunk highway

A HIGH-LEVEL CONCRETE VIADUCT of six two-rib arch spans flanked by several deck-girder approach spans now carries U. S. Route 22 over the Little Miami River Valley at Fosters Crossing, Ohio, eliminating a bad grade crossing and one of the worst stretches of main highway in the state. The improvement, which involved considerable road relocation, is on the popular and congested "Three C's Highway" between Cincinnati and Columbus. Formerly the highway wound a tortuous narrow course down the side of the valley, through the village of Fosters, where the buildings bordered the road so closely that they constituted a traffic hazard, crossed the stream on an old through-truss bridge with a 17-ft. plank roadway, crossed two high-speed tracks of the Pennsylvania R.R. at grade and threaded a winding way up the other side of the valley. The old road and bridge were in poor condition and so wholly unsuited to modern traffic requirements as to preclude efforts to correct the situation by anything but a major relocation.

The project includes the viaduct, 1,404 ft. long, and a 65-ft. bridge over Bear Creek in the east approach road. All of the old facilities have been left for local service. The new route is 6,628 ft. long between connecting points, while the original route is 7,834 ft. between the same points.

All right-of-way is furnished by the state highway department without local contributions. The improvement cost $505,290, of which $306,290 for the viaduct came from federal grade crossing funds. To meet the remaining cost, $90,148 was allocated to the approaches from regular federal aid allotments, supplemented by $108,852 from state highway funds.

The viaduct consists of six main arch spans varying from 155 ft. to 175 ft. center to center of piers, with a rise of 50 to 60 ft., and ten deck-girder approach spans from 33.25 to 40 ft. long, three at the west end, seven at the east. A descending grade of 2 per cent on the roadway from west to east accounts for the variation in arch span length, for the designers wished to maintain a definite relation between span and rise for the sake of appearance. Because of a steeply rising bank at one end of the arch section, the south end span is unsymmetrical.

Except for varying dimensions, all of the arch spans are similar. They are of the open-spandrel type, consisting of two ribs 6 ft. wide. Each span carries eight or nine two-post concrete bents that support the roadway; two bents are used at each pier. The two ribs are connected by 1½x2-ft. horizontal concrete struts at two points on each span. See accompanying drawing.

The foundations were relatively

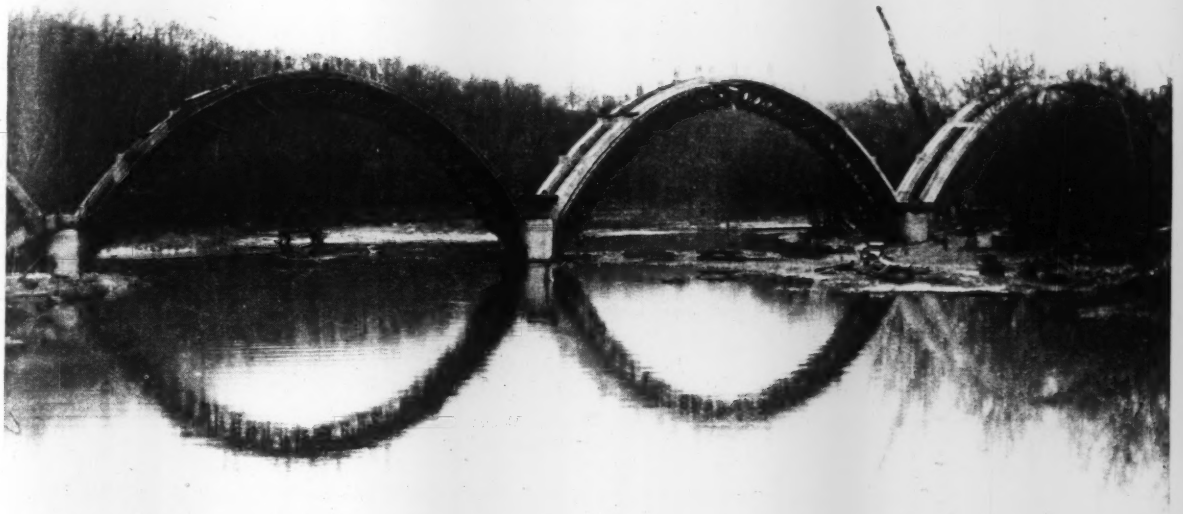


Fig. 2. Graceful arches characterize the new crossing of the Little Miami River on Cincinnati-Columbus highway.

simple; all except three of the piers are on spread footings carried down to firm material. Piling was required under the arch pier in midstream and the two on shore near the river bank. The arch piers are hollow structures, with circular ends, 28 ft. high above foundation mat. Umbrella haunches for support of the arch ribs are integral with the pier shafts.

The approach spans are carried on pairs of rectangular concrete piers with individual footings, each pair being connected transversely by a concrete strut set parallel to and just below the ground line.

The roadway, which crosses the river 76 ft. above water level, is 24 ft. wide with a 3-ft. sidewalk along one side. A heavy concrete railing 3 ft. high guards the edges of the viaduct. For the arch spans the deck consists of a 12¾-in. concrete slab, carried on a frame of fascia girders and transverse beams at the bents. The approach span deck structure is a 7½-in. concrete slab carried on five longitudinal concrete beams spanning between heavy cross girders at the piers.

Expansion of the deck is provided at one intermediate pier on the seven-span east approach, at the junction of the approach and arch spans, and at each arch span pier.

Drainage of the roadway is through gutters of copper-bearing steel bulb angles, 5x3½x⅜ in., set at the junction of slab and curb. The bulb leg of the angle is placed toward the center of the roadway, while the other leg is against the curb face to form the gutter. Gutters are anchored through short 8-in. channel sections buried in the slab concrete and supported on the forms during construction by adjustable bolts.

Construction

Chief interest from a construction standpoint lies in the use of wooden truss centering for the arches, fabricated at the site with split ring connectors. This feature is covered in the next following article.

Even though the bridge crosses the stream just above a low mill dam, the normal water depth is very shallow. Foundation construction was, therefore, a simple procedure. The

Fig. 3. A much-needed grade crossing elimination (left) is provided by the new bridge. Formwork for the deck structure (right) rises above the slender arch ribs.

shallow water permitted crawler cranes to work out in the river.

Long-boom cranes were required for erecting the arch centering, and the same plant was used in placing the rib concrete. A receiving hopper with chutes leading down each side was set up on top of the rib forms. Concrete was mixed in a standard paver working from the valley floor, and was transferred by bucket to the receiving hopper by the cranes. Specifications required that no rib be poured until the forms were in place on the two adjoining spans. One rib was poured all the way through, then the forms were shifted to complete the second rib. For placing of the spandrel and deck concrete the plant was set at deck level and concrete was placed by buggy.

The project is being built by the Ohio Department of Highways, of which John Jaster, Jr. is director. Plans were prepared under the direction of K. L. Rothermund, chief engineer of location and design, and J. R. Burkey, chief engineer of bridges and grade crossings. Construction is under the direction of Elmer Hilty, chief engineer of construction; Walter E. Willard is division engineer and Chas. E. Kunker is resident engineer on the project. W. V. Buck, district engineer, represents the U. S. Bureau of Public Roads. Contract for the work is held by the W. L. Johnson Construction Co., Hicksville, Ohio; Fred I. Rowe, president, is directing the job.

Long-Span Timber Arch Centering

WM. W. CARLTON

Carlton, Frankenberger & Batson, Engineers, Cincinnati, Ohio

Ring connectors permit economical design of form support for multiple-span concrete highway bridge

THREE-HINGED timber arches, with split-ring connectors for joint framing, were used as centering for the six arch spans of the new high-level bridge at Fosters Crossing, Ohio, described in the preceding article.

The main bridge consists of six spans of two-rib open spandrel concrete arches supporting a deck structure having a 24-ft. roadway and a 3-ft. sidewalk. Arch spans vary from 155 ft. to 175 ft., c. to c. of piers, with a clear rise above springing line of about 72 ft. Ribs are spaced 18 ft. 6 in., c. to c., each rib being 6 ft. wide and varying in thickness from 4 ft. at the piers to about 2 ft. 6 in. at the crown. The roadway of the bridge will be some 80 ft. above pool stage of the river.

The W. L. Johnson Construction Co., contractors for the bridge, selected an arch type of rib centering because of clearance requirements and heavy traffic conditions on both the railroad and the highway over which the new bridge is built, and because of the danger of high and sudden floods on the river. Timber construction was chosen because it indicated a saving in cost, permitted fabrication at the site with the contractor's own forces, and allowed salvage of material from the trusses for reuse in building falsework for the deck structure.

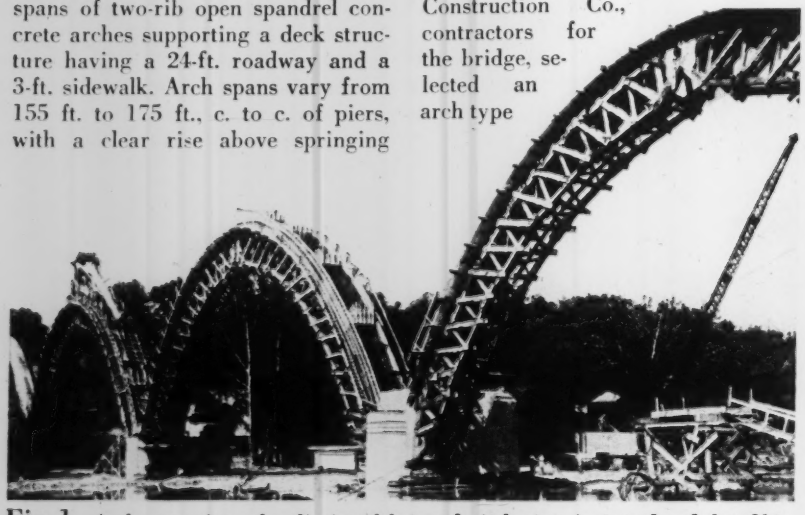


Fig. 1. Arch centering of split-ring fabricated timbering is introduced by Ohio contractor on Little Miami River bridge.

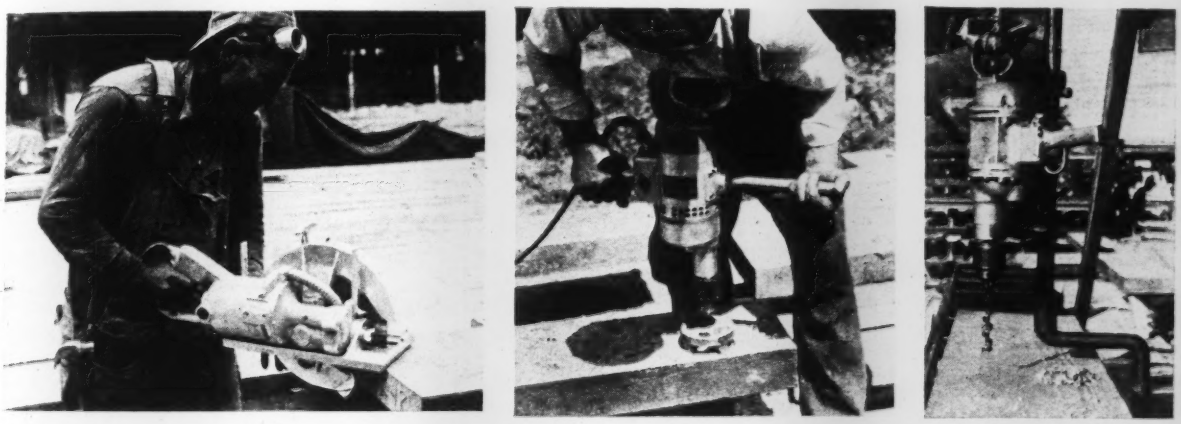
Because of high cost and excessive deformation, truss-type centering of timber is generally considered to be undesirable where intermediate supports can be used. However, the modern timber connector has made possible both economy and increased rigidity; expensive hardware is eliminated and at the same time a joint efficiency is obtained which permits sizing of members for actual web and chord stresses only. A difficulty with timber arch centering has been the development of cracks at the haunches during construction, due to distortion of the falsework. This difficulty was eliminated on this job, by the type of design used.

Centering design

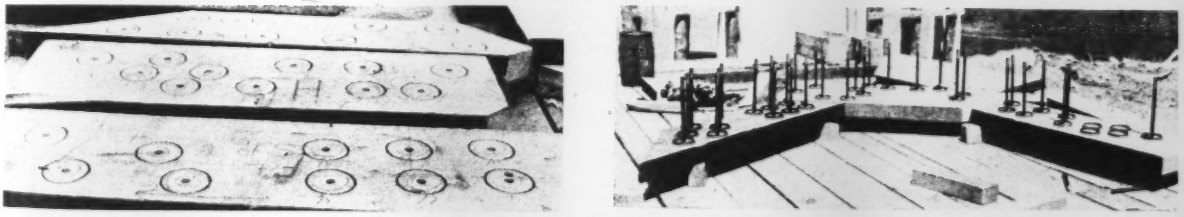
The centering for each span consisted of two three-hinged arch trusses latticed together to form the support for one concrete rib. Lower hinges were set on a sill plate supported on piles or on posts resting on the pier footings. Blocking between sill and lower plate provided jacking space for raising and lowering the centering. After one rib of a span was poured, the centering was shifted sideways into position for the second rib. Highway department specifications required that no arch could be poured until centering for both adjoining arches was in place, and that no centering could be struck until both adjoining arches had been poured. These conditions, plus the fact that no two arches have the same span, required construction of falsework arches for five spans. The arches for the first span poured were altered for use in the sixth span. The largest timber arch had a span of 157 ft., c. to c. of hinges, and a rise of 61 ft. 6 in. to crown hinge. The smallest arch had a span of 136 ft. and a rise of 44 ft. One span was unsymmetrical. So far as is known, these are the largest tim-

DETAILS OF FABRICATION

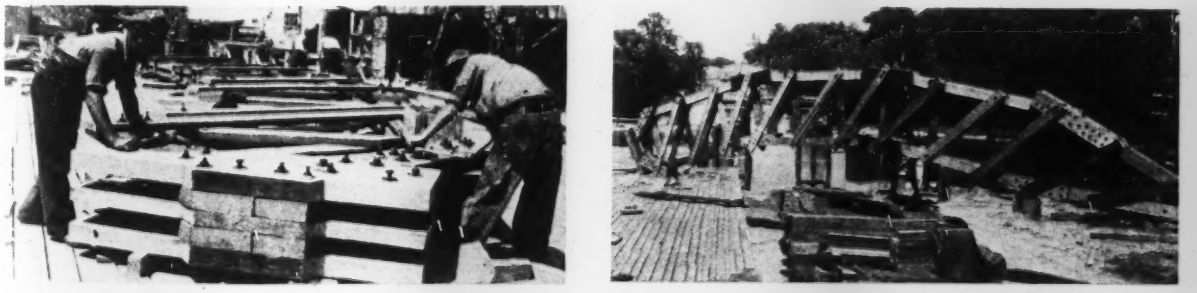
Fig. 2. Details of operations in fabricating the timber trusses. (Left) Arch templates are laid out on the working deck. (Right) End cuts are marked and bolt holes located by punching through the template, temporarily nailed to the piece.



(Left) Members are cut to shape with a portable saw. (Center) Ring grooves are cut out by a boring machine. (Right) Drill on pivoted offset mounting covers wide area.



(Left) Members cut to shape, bored for bolts and grooved for rings, ready for assembly. (Right) Fabricated members, fitted with bolts and rings, are laid in position for assembling.



(Left) Bolts are given a final tightening after assembly of the truss members has been completed. (Right) An 80-ft. section of timber truss on its way from fabricating deck to position in the arch.

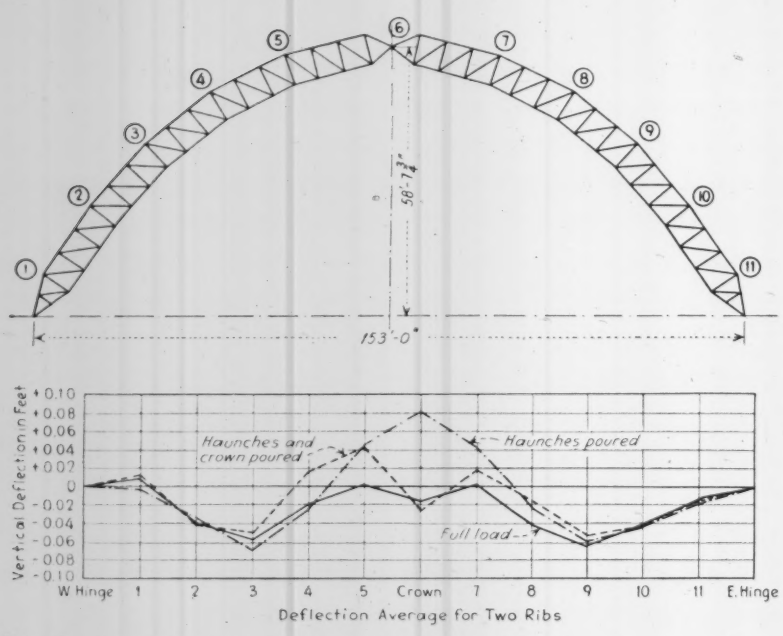


Fig. 3. Deflections of the timber trusses under various loading were carefully computed in advance

ber arches ever used in this country for bridge centering.

The trusses were analyzed first for dead load plus haunches poured; second, for dead load plus haunches and crown poured; and third, for full live and dead load, in accordance with pouring sequences specified. Maximum stresses from these loadings were used for design of joints and truss members. Pacific Coast fir was selected for all chord members. No truss timbers were larger than 4x16 in. or longer than 20 ft.

A typical truss was developed which formed the basis of all of the trusses. Changes in span and rise were obtained by adjustment in the haunch sections only, all trusses being identical in outline through the center section.

Joints were standardized to effect economy in layout and fabrication. Typical joint details are shown in Fig. 4. Working loads for connector rings were based on specifications of the Timber Engineering Co. Rings of 4-in. diameter were largely used, though a few 2½-in. and 6-in. rings were required.

Fabrication

A wooden working platform large enough to accommodate the largest half-rib was built on the site adjacent to the bridge. On this platform the trusses were laid out and truss members cut, bored, grooved and assembled. All chord members were delivered to the job cut to exact length to save field labor and equipment. The design was made to permit the use of square-end timbers throughout. No bevels or special cuts were required except at the haunches and crown.

In the design of the trusses, all panel joints were located by computed offsets from a base line through the hinge points. By this means trusses were easily laid out on the working platform. Redwood templates were placed over the truss layout from which all bolt holes were spotted and drilled. These templates were then used to mark all truss members, which were prepared ready for assembly before being placed in position in the truss. Thus it was

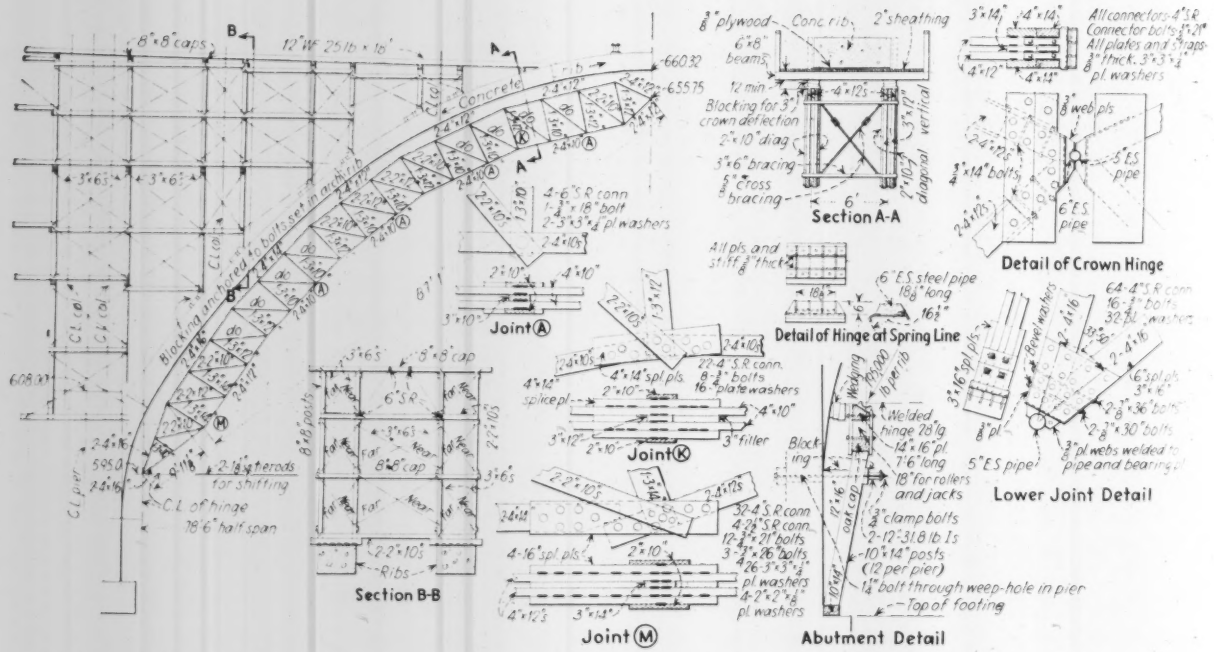


Fig. 4. Design of a typical truss section and details of joints and framing.

possible to assemble one truss unit on the platform while members for another were being prepared. Assembly of one unit required about a day.

Erection

In erecting trusses for the first span over the highway, the two ribs for each half span were raised separately, temporarily supported on shear-legs, and latticed together in the air. The crown hinge connection was then made by jacking. On subsequent erection the two ribs of each half span were completely assembled on the ground with the lower hinge joints in position and the two halves raised in succession, lowered to position and the crown hinge connection made. Formwork was built upon the supporting ribs and was blocked up to the line of the finished concrete. All rib forms were lined with plywood.

Trusses were set slightly high at the crown to allow for deflection due to shortening under load. During concreting of the haunches, the crown section was partially loaded to counteract the tendency of the crown to rise. The trusses proved remarkably stiff under load, as shown by the deflection diagram in Fig. 3 which illustrates the action of a typical span.

Shifting and dismantling

In shifting into position for the second rib of a span, side forms were removed and the entire falsework dropped clear of the completed rib by lowering the hinges at the springing line. Arches were then easily jacked sideways on pipe rollers into position for the second rib. No ties were required during shifting, well greased steel slide plates behind the sill timber allowing easy movement.

In dismantling the trusses, the centering was lowered clear of the concrete, and the rib formwork and lagging was removed. The crown of each half truss was then lashed to the concrete rib, and the center hinge broken by dropping the lower hinges. Each half was then lowered and dismantled on the ground. Lumber, bolts and connectors from the trusses were later used for constructing deck falsework which was supported on the concrete ribs.

The use of timber arch trusses was conceived by Fred I. Rowe, head of the W. L. Johnson Construction Co. The trusses and deck falsework were designed by Carlton, Frankenberger and Batson, consulting engineers of Cincinnati. The split ring connectors were furnished by the Timber Engineering Co., Washington, D.C., which also assisted in the fabrication. Personnel of the state highway department connected with the project was given in the previous article.

Timber and Concrete Strength

Conference at Cambridge discusses advances and problems of two major construction materials

CURRENT KNOWLEDGE relating to strength of wood and concrete were dealt with at a conference on materials held at Massachusetts Institute of Technology July 7 and 8. Timely facts of both design and construction practice were brought out.

Papers on timber dealt with "form factors" that define the strength of beams, the part played by lumber grading in correlating material and use, and protection against deterioration. In concrete the principal subjects were cements for specific kinds of service and the strength of concrete as influenced by modern production methods. Question was raised about the validity of design assumptions for concrete dams.

Form factors of timber beams

In outlining the use of form factors in the design of wood beams, L. J. Markwardt, of the U. S. Forest Products Laboratory, Madison, Wis., first emphasized the complexity of wood as represented by its several different elastic moduli and Poisson ratios and its makeup of slender fibers. Despite this complexity, small wooden test beams conform closely to the conventional bending formula $M = SI/c$, though the computed stress at the proportional limit is greater than that found from test pieces in direct compression. The difference is attributed to incipient buckling of the minute fibers at the most highly stressed elements, and transfer of load from these fibers to adjacent fibers less highly stressed.

Since the amount of this fiber support in deep beams is less than that in the 2-in. square test beams and differs with the shape of the cross-section, a "form factor" calculated from an experimentally determined formula should be used. For a circular section the form factor is 1.13; for a rectangular beam 8-in. deep it is 0.93, for I-shaped beams in some instances as low as 0.50. When these form factors are applied to working stress, the normal I/c value may be used in design.

Differences from the principles applied to beams of other materials appear also in horizontal and shear. Yield of the wood in shear causes the ends to act in effect as double beams; for design it may be assumed that this double-beam action extends inward from each end three times the depth.

Fatigue effects in wood have not been fully explored as yet, but tests carried to a few million cycles showed no change in elastic properties except that the proportional limit under repeated load is about 40 per cent of the ultimate strength in place of 55 to 60 per cent under single loading. Impact up to 100 per cent may be ignored because wood is stronger under impact than under slow loading.

Lumber grading

Lumber grading, in practice lags behind the rules and stresses worked out by scientific procedure, said L. W. Smith, chief engineer, National Lumber Manufacturers Association, Washington, in a paper on develop-

ment and control of lumber grading. Working stresses are applied to structural lumber, which is graded on the basis of strength, while yard lumber, "the stuff of which America is built," is graded on appearance rather than on strength.

Structural lumber is graded in conformity with the definitions of quality and defects contained in the American Lumber Standards and under rules worked out by the various lumber associations. An important advantage of the official grading practice is that grade marks applied to the lumber after inspection (when called for by the purchaser) assure conformity of the material to the established quality standard. Special inspection certificates may also be obtained.

Deterioration of wood

Dr. Charles H. Blake, of Massachusetts Institute of Technology, reviewed the chief wood-destroying agencies, both those that feed on wood and those that use wood merely as a dwelling place. The former class includes fungi, termites and beetles, the second such animals as shipworms, the gribble and the carpenter ant. In respect to fungus attack Dr. Blake emphasized that it does not harm dry wood, but infection present in trees or lumber may lie dormant a long time. Permanent dryness or quick drying of the wood are essential to protection. Of the marine parasites, in addition to the clamlike teredo and the shrimplike limnoria, a second small shrimplike animal, *chelura terebrans*, is now attracting attention, but Dr. Blake stated that while it occurs in holes in wood it is not certain that it can attack sound wood.

Avoidance of wet or moist conditions to protect wood was further emphasized by George M. Hunt, of the Forest Products Laboratory, in "Preventing the Deterioration of Wood in Service." To keep the wood continuously dry or cause it to dry quickly when it becomes wet, essential precautions are avoidance of contact with the ground, prevention of water accumulation from leaks, avoidance of improper design or defects in the structure, and protection against condensation from high humidity. For moist conditions either wood of high natural decay resistance or wood impregnated with preservatives should be used.

The "oldest and most reliable" preservatives for outdoor and indoor use are coal-tar creosote and zinc chloride, but promising newer preservatives are available. Good treatment is essential. In protection against termites mechanical barriers are often required in addition to preservatives. Marine borer attack is retarded most effectively by heavy creosote treatment.

Cement composition

P. H. Bates, of the Bureau of Standards, Washington, in speaking of "Relation of Cement Composition to the Quality of Concrete," contrasted the long use of a single standard for portland cement in the United States with the use of numerous cement types in Europe, a difference largely due to the historical development of the art in the two countries.

Changes in cement demand and production practice have modified the prevailing cement type. Originally the impure limestone of the Lehigh Valley set a standard that was tacitly adopted as defining the composition of the best cementing material, and Hudson Valley materials, containing more iron, eventually had to be modified by the addition of other materials to duplicate the Lehigh Valley type. Many consumers now, however, want something approaching the original Hudson Valley type, and Lehigh Valley practice has had to be modified to produce that type of cement.

Highway use is one of the most severe services of concrete, Mr. Bates said, because of stress, temperature change, humidity, freezing and thawing, and ice-melting chemicals. Cements other than standard portland have been tried in this service with some success. The present trend is to a less basic cement with lower aluminum, but there is a marked lack of data, and "it is fortunate that guesses as to the best highway cement composition have generally been in the right direction."

Mass concrete matters also are still in flux. The low-heat cement brought to the front by the setting-heat problems of Boulder Dam gave a reduced volume change, and also supplied other desirable qualities, as higher tensile strength. It is not impossible, however, that standard portland, if cured to give lower heat rise, may provide the best all-around quality. There is a promise of excellent properties through low-temperature curing (at freezing or below for a day or two) followed by high-temperature curing.

Workability and protection against strength loss from drying are the prime desiderata in cement for reinforced concrete. The problem of water-resisting cements is an old one, as demand for a material to resist sea-water attack has existed virtually since the first days of portland cement. Low solubility of the cement in pure water is as important as sulfate resistance, however. Blends of natural and portland cement were used years ago in the United States, among other things in the walls of the Pennsylvania Railroad track elevation west of Broad Street Station, Philadelphia, which have proved very difficult to remove.

In reply to the question of how the engineer shall specify cement if neither raw composition nor compound composition is practically usable, Mr. Bates said that much further research work is needed to give a basis for specifying.

Concrete variability

Discussing the effect of various elements of present-day concrete practice on the strength of concrete, Miles N. Clair, Boston, presented some informing figures on test cylinder strengths actually obtained on some 14 small and medium-sized New England concrete jobs totaling about 100,000 cu.yd. The range in strengths at 7 days was from about 70 per cent above average to 75 per cent below average, and at 28 days from about 60 per cent over to 55 per cent below average. The observed slumps showed an equally large range in values.

Shortcomings of present concrete practice, according to Mr. Clair, include the lack of a generally applicable formula for proportioning, which usually makes it necessary to try a number of mixes; the absence of a satisfactory workability measure (often the truck-mixer operator can judge the workability of the concrete better than the test laboratory man); variations and defects of mixers; the fact that usually there is too little placement labor and too little direction of placement; and variations in curing—this latter causing the qual-

ity of the concrete to vary markedly with the season.

Water pores in concrete as shown by microsections received emphasis through a paper by Prof. W. C. Voss, of Massachusetts Institute of Technology, on "Microstructure of Concrete vs. Strength." Poisson's ratio for concrete was discussed by Prof. D. Peabody, Jr., of M.I.T., and rubber mountings for use in connection with concrete structures by F. L. Haushalter, of the B. F. Goodrich Co., Akron.

Extensive disagreement between actual stress conditions in masonry dams and those assumed in design were discussed by A. P. Karpov, consulting engineer, Pittsburgh. The differences are due to volume changes, separation of parts, horizontal shear distribution, stress concentrations, interaction of dam and foundation, and three-dimensional stress conditions.

Mr. Karpov brought out that important stress concentrations exist in dams, arising in large part at the contact between dam and foundation and reflected thence throughout the structure. The assumed linear stress distribution does not apply to dams. Three-dimensional stress conditions require the interaction of elastic and plastic deformations to be considered, and together with stress concentrations make it desirable to "streamline" the form of a dam in order to reduce stress peaks.

In specific cases which he discussed, peak stresses three or four times the ordinary calculated stresses occur. Large peaks are introduced by cutoff or anchorage walls at the heel, which distort the shear distribution, and by the abrupt changes in stressed section which occur at the contact between foundation and triangular dam profile. Heavy filleting at heel and toe reduces the resulting stress concentrations greatly. Reinforcement should be avoided in massive dams, because of the restraints which it introduces and the resulting danger of cracks.

Controlled Maintenance Costs

R. R. MacLeod

Chief Accountant, Illinois Division of Highways, Springfield, Ill.

A system of highway maintenance cost accounting that takes into account both the upkeep of property and the efficiency of transport service

Modern highway maintenance has two duties: One is to preserve original property investment by repairing the damage of natural wear and tear and the other is to give road transport safe and ready service. The system of maintenance cost accounting outlined in the article that follows has special interest because of its positive recognition of these two duties of maintenance—property preservation and operating efficiency. The author has intelligently shunned details to make general principles and practices stand out clearly and give the article interest to the general engineer reader.—EDITOR.

THE HIGHWAY maintenance cost accounting plan developed in Illinois for the maintenance of about 13,000 mi. of highways has been planned with a view of controlling such costs by making possible comparisons (1) of information gathered in each district with others, (2) the cost of work done by each patrolman with others, and (3) the cost of maintenance operations for the same type of road and for comparable periods with each other.

The State of Illinois, for administrative purposes, is divided into ten geographical units or districts with a district engineer in charge of all work in each, whether construction or maintenance. A district maintenance engineer is in charge of the maintenance work in each district and is responsible directly to the district engineer. Each district engineer, in turn, is responsible for maintenance work in his district to the engineer of maintenance in Springfield who is in charge of such work over the entire state. Each district is subdivided into three or four subdistricts with a field engineer in charge. Working directly under the field engineers are maintenance supervisors who supervise and direct the work of five or six maintenance patrolmen. Each maintenance patrolman is assigned to a certain section of the highways and is given standard equipment. At certain seasons of the year the patrolmen are given extra help by the employment of common labor.

Maintenance costs are collected by patrols grouped to form maintenance sections, and consist of certain construction sections built of the same type, width, design and year of construction. The patrols throughout the state will average about 5 mi. in length.

A grouping of about four patrols forms a maintenance section (Fig. 1) to which a patrolman is assigned. Patrols being established, no changes may be made in the grouping of the construction sections forming them without the approval of the engineer of maintenance and the auditing bureau, which rarely is given. This method prevents the constant changing or shifting of patrols forming the basis for maintenance cost collection and makes comparisons of cost possible over long periods of years or during the life of the pavements.

A system of patrol marking or numbering has been originated, whereby the first number indicates the district, the second the type, while the numbers following furnish indication as to the age of the road, the oldest roads being numbered first. This method of numbering patrols permits of an unlimited expansion of patrol numbers in each district and furnishes a ready means of automatic tabulation of maintenance costs by district, by type, by age, by route, etc.

Sketch maps showing the physical layout or limits of each maintenance section with patrol markings have been prepared for each district to conform to the physical markings in the field. These maps indicate the construction sections which have been grouped to form patrols.

Patrols are organized along routes and ordinarily do not overlap at junction points. This arrangement makes possible the collection of maintenance costs along routes or between towns or junctions without difficulty and allows considerable flexibility. The arrangement also makes comparisons of maintenance costs with traffic information possible. Patrols, while not subject to change, may be grouped in any manner desired to form maintenance sections, thus giving flexibility to the assignment of work to patrolmen without in any way interfering with the basic patrols on which the cost data are collected. The renumbering of routes therefore does not in any way interfere with the gathering of costs.

Division of costs

Illinois not only considers that it has a highway system to maintain, but that it is also in a somewhat similar position to a railroad in that it is operating a statewide transportation system as well.

The strictly maintenance features of cost collection have therefore been separated from those which are classed as operating costs. Operating costs are considered to be those items which apply to serving the traveling public, improving the appearance of the highways and guiding and warning traffic.

Maintenance costs for each patrol are collected under the following major cost accounts:

1. Slab or surface
2. Shoulders, ditches, cuts and fills
3. Large bridges and viaducts (100 ft. over-all length or more)
4. Small bridges (concrete and steel less than 100 ft. over-all length)
5. Culverts and other drainage facilities
6. Miscellaneous structures and facilities

Under slab or surface, the following sub-accounts or operations have been provided: (1) Pavement or surface patching or repair; (2) black top patching on concrete pavements; (3) crack filling; (4) joint filling, trimming or cutting, and (5) mud jacking.

Under large bridges and viaducts of 100 ft. over-all length or longer, maintenance costs are collected for the following operations: (1) cleaning; (2) repairing, and (3) repainting.

No attempt is made to break down costs on shoulders, ditches, cut and fills, small bridges, culverts and other drainage facilities and on miscellaneous structures by maintenance operations.

All costs under major accounts and sub-accounts are broken down under the headings of: (1) labor; (2) materials; (3) expense, and (4) overhead.

Labor hours are collected along with labor costs and are used as a means of distributing section expense, district expense and a share of the general office expense chargeable to maintenance.

Costs classified as operating charges are collected by maintenance sections as follows:

(1) Markers and safety signs
(2) Guard fence
(3) Cutting and clearing vegetation
(4) Cleaning dirt and debris
(5) Snow and ice removal and control
(6) Roadside planting and landscaping (maintenance)
(7) Subway and drainage pumping
(8) Electric and other forms of lighting

Costs for these items are further broken down under the following sub-accounts: (1) Labor; (2) materials; (3) expense, and (4) overhead.

Collecting and assembling costs

The Illinois Division of Highways operates under a decentralized plan of cost collection whereby maintenance as well as other costs are collected first by the district offices. The information collected in each district office is based on daily reports submitted by field forces. The time cards used by the patrolmen are interchangeable for various kinds of work. The information shown on the original record copies through on a "Keysort" card. These cards are collected daily by the maintenance supervisors and are forwarded to the district offices where they are checked for labor rates, extensions, account numbers, and where they are keypunched to designate the maintenance section, patrol number, cost account and whether the work was done by the patrolman or by a maintenance gang.

The payroll information shown on the card is then transcribed to an earnings card which is maintained for each patrolman. The earnings records are posted on a duplex adding machine and at the close of the payroll period, payrolls are prepared.

Control cards are set up for each maintenance section against which the labor cost record must balance at the close of the payroll period and a general control is provided against which the payroll itself must balance, thus insuring the accuracy of the payrolls.

Materials and expense supplies required for maintenance and operation work are covered by estimates submitted by the field engineers which are prepared after interviewing the maintenance supervisors. These estimates show the maintenance sections, patrols and cost accounts to be affected. As materials and supplies are received, charges are made accordingly on a special card which has been provided for distributing such charges. These cards are keypunched and at the close of the month, the information contained thereon is posted along with labor and expense costs to a summary card which is maintained for each patrol and for each maintenance section insofar as operation charges are concerned.

From the summary cards, which are also keypunched, monthly reports may readily be prepared on the duplex adding machine for submission to the auditing bureau. These reports, when received in the auditing bureau, are balanced against a recapitulation of schedules which carry the payrolls, invoices, etc., currently for payment.

At the close of the year, annual cost reports are made for each patrol insofar as maintenance is concerned and for each maintenance section where operating costs are being reported. These reports, after a spread of the general office overhead has been made, are filed in binders by

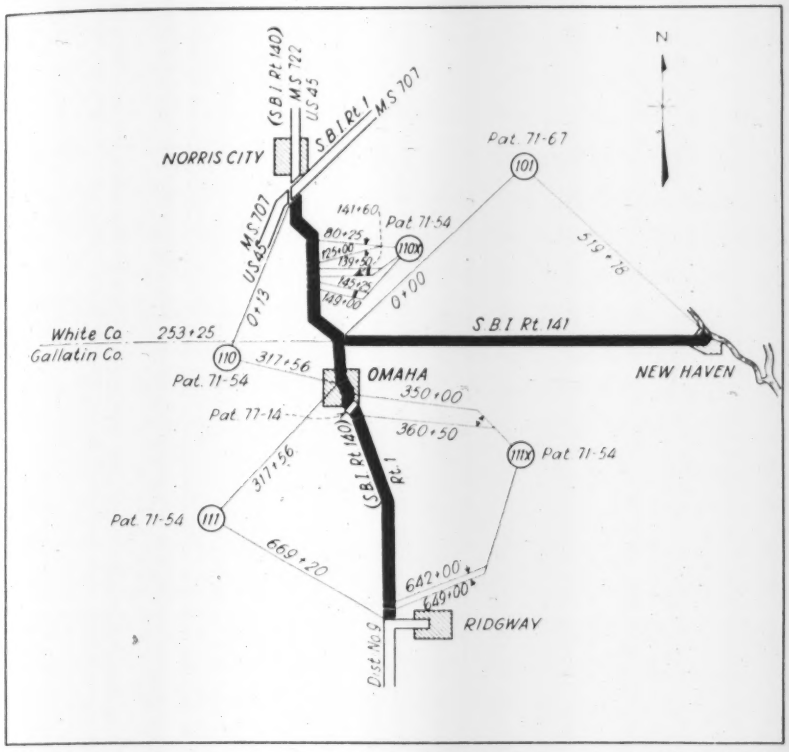


Fig. 1. Maintenance sections on the Illinois state highway system are mapped and marked as indicated by the sketch above.

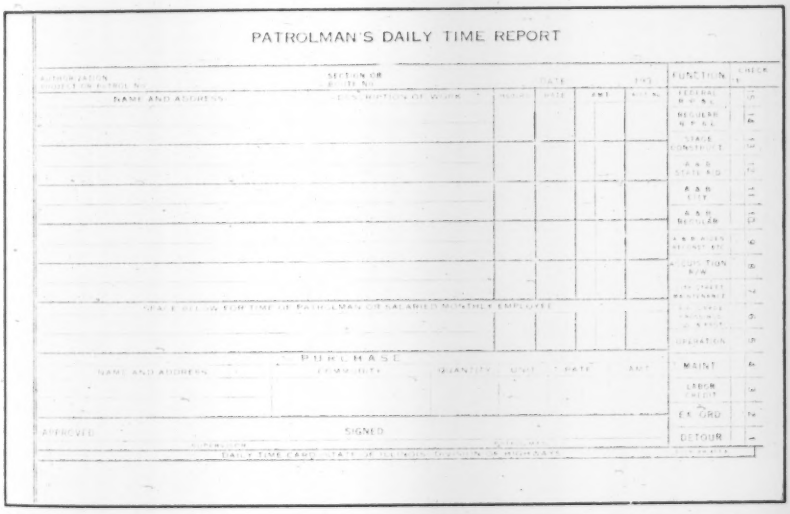


Fig. 2. The basis of all cost records is this daily report form with carbon back which copies through onto a "Keysort" card. Such cards are used for virtually all records indicated in this article.

calendar years in patrol and maintenance section number order.

Forms and equipment used

In designing the Illinois method of maintenance and operation cost collection, we have been particular to design forms which are simple, so as to facilitate cost reporting in the field and to expedite collection in the district offices. After an exhaustive study of various methods and plans of collecting maintenance and operating costs, it was decided to install the "Keysort" method and a Burroughs duplex adding machine in each district. The following forms were designed as a part of the system:

1. Patrolman's daily time report.
2. Earnings record card.
3. Section cost control card.
4. Material debit and credit card.
5. Maintenance monthly cost summary card.
6. Operation monthly cost summary card.
7. District engineers monthly report of maintenance costs by type of road.
8. District engineers monthly operating cost report.
9. Annual cost report for each maintenance patrol.
10. Annual cost report of operation for each maintenance section.
11. Annual cost report for large bridge patrols (100 ft. overall length or more).

As a result of this method of gathering maintenance and operation cost information, the Illinois Division of Highways is in a position to determine whether the cost of certain maintenance operations are comparable in the districts, and may readily locate excessive or unusually heavy maintenance expenditures and determine the reasons therefor.

The division also is in a position to gather a very complete analysis of such costs by years for any selected route, type, width, design, etc. and as various types of roads become older and as traffic conditions change, to determine from the records what the increases in cost are from year to year.

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Shanties for New York WPA Built in Central Shop

In an effort to improve the appearance and efficiency of its work sites in New York City, the Works Progress Administration there is turning out portable wooden shanties, traffic barricades and safety fences, all of uniform design and size, at a central woodworking plant and mill. The plant serves all five boroughs of the city and employs about 400 men.

Woodworking machinery formerly used in the manufacture of desks and other office furniture early in the emergency program is being utilized to produce the shanties and other WPA equipment.

The plant is also used to make moldings, carvings, and other wood fittings no longer readily available in the market for the restoration of old structures of historic interest.

FROM FIELD AND OFFICE

Working problems and time-saving methods . . . Edited by Charles S. Hill

Laboratory Concrete Saw

CHAS. E. WUERPEL

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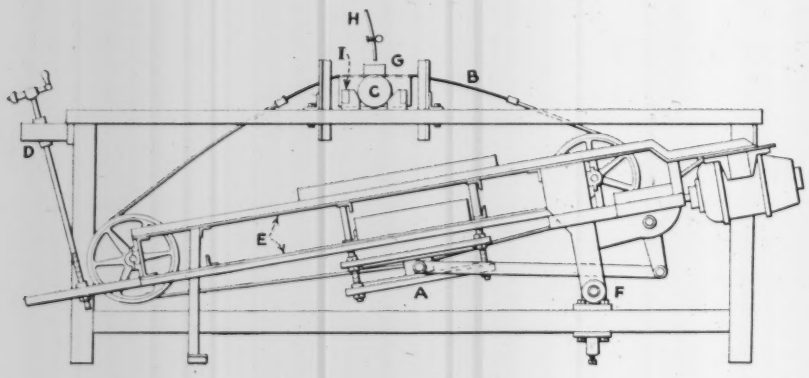
The inexpensive concrete saw illustrated, and now used in the Military Academy laboratory at West Point, was devised by the writer while at Passamaquoddy to provide a more economical method of sawing. The design embodies the wire method commonly used by quarries for cutting large slabs of stone in place, and is also a modification of the circular-wire cutting device sometimes used but the reciprocating action of the wire obviates the use of the endless wire loop.

Referring to the illustration, the motor-driven cross-head *A* provides a 14 in. stroke to the 44-in. No. 9 soft-iron baling wire (B) which, in passing through the specimen (C), acts as a vehicle for the No. 46 alundum powder which is the actual cutting medium. Proper tension of the wire is maintained by the threaded rod (D) which elevates or lowers the carriage (E). The balanced carriage is suspended from the bearing (F) which acts as a fulcrum. By gradual rotation of the carriage (E) about the fulcrum (F) a constant angle of cut, as well as proper tension, is maintained. The abrasive powder is placed in the elongated funnel (G) and washed onto the wire with water from the rubber hose (H). The specimen (C) is held rigidly in place by the sloping faces of the cast-iron dogs (I) which permit either a lateral or a longitudinal cut through 6x12 in. cylinders. By changing the position of the dogs, square specimens may be cut.

About 2½ hrs. are required to cut longitudinally through a cylinder containing limestone and about 3½ hrs. through a specimen containing basaltic traprock. Normally, two 44 in. lengths of baling wire are required to make a longitudinal cut and about 9 lb. of alundum powder.

The slightly serrated surface produced by cutting may be removed by converting the saw into a polishing device by removing the dogs from the table surface and placing a machined-metal polishing platen on the table.



Wire saw for cutting concrete specimens can be converted into a polishing device.

* * *

Embossed Traffic Arrows

In recent California pavement marking to guide traffic use has been made of arrows embossed on the surface as illustrated. The arrows are spaced 10 ft. on centers except at intersections or entrances where raised crescents mark the ends of the row of arrows and thus help to indicate crossings. The arrow thickness is ¾ in. and there is a bevel (0.02 to 0.06 ft.) on the edge facing oncoming traffic; the cost per arrow ranged from about 50 to 80c. each.

The surface on which the arrows are placed is first treated with a black priming coat applied at the rate of 0.05 gal. per sq.yd. To provide proper bond with the pavement a grade *D* tack asphalt coat is then put on. On this the raised arrows, 6 in. wide, 3½ ft. long and ¾ in. thick are built up in templets of plant-mix of a 90-95 road oil cut back with 15 per cent of kerosene.

Raised arrows in the central dividing strip on a highway near Long Beach, Calif.

On a typical installation a crew of 7 men and a foreman placed about 200 raised arrows per 8-hr. day. A separate crew of 3 men using a 5-gal. spray outfit put on the two coats of white traffic lacquer that completed the job.

* * *

It's Done with Mirrors

BENJ. C. SEAL

Senior Draftsman, Hubbel, Roth & Clark, Inc. Detroit, Mich.

In driving shield tunnels it is necessary to know the pitch of the shield at all times, that is, whether it is pointing up, down or is running level. On the Detroit outfall sewer tunnel the pitch indicator consisted of a plumb bob suspended alongside a longitudinal bulkhead. Just above the plumb bob was set a horizontal ruler, placed against the bulkhead parallel with the axis of the shield. The rule was graduated so the plumb bob string fell opposite the zero mark when the shield was level; readings to the right and left indicated the pitch.

Gradually the shield rolled on its horizontal axis, so much so that the plumb bob swung too far out into the working chamber to permit accurate reading of the scale. As the rule could not be moved the following method was worked out to take the required readings.

The writer placed an inexpensive

mirror against the bulkhead behind the rule. By keeping the string between the observer's eye and the mirror, and lining up the string with its image in the mirror, an accurate reading could be obtained. The line of sight always cut the rule at the right-angle projection between the string and mirror.

• • •

Precast Concrete Slabs Replace Planks

Economical replacement of a deteriorated timber deck on an old bascule highway bridge was accomplished recently by the California Division of Highways by using 2-ton, precast, reinforced concrete slabs, made of light-weight aggregate and only 4 in. thick. The bridge crosses the Sacramento River at Paintersville, Calif.; was built in 1923 and the channel crossing has two 113-ft. bascule leaves with a 17½-ft. roadway. The old floor system was steel beams which carried 4x6-in. transverse sleepers at 14-in. centers covered by 1x6-in. diagonal planks, 3-in. creosoted blocks and a ½-in. asphaltic surfacing. The old floor weighed 22 lb. per sq.ft., the precast slab construction increases the weight to 38 lb. per sq.ft.

The slabs were cast nearby, whence they were picked up from the forms and set in place on the bridge by a truck crane. Anchor bolts ⅝ in. in diameter fastened the slabs to the steel stringer supports, ten bolts to each unit. Shims were used where necessary to give a uniform bearing on the stringers. The slab sizes are 6x19 ft.; the 19-ft. dimension includes allowance for curb. The slab thickness is uniformly 4 in. Tests of the concrete after 28 days show a strength of 2,600 lb. per sq.in.

Simple Subsoil Sampler

E. C. SEIBERT
Commander U.S.N., Naval Air Station, Almeda, Calif.

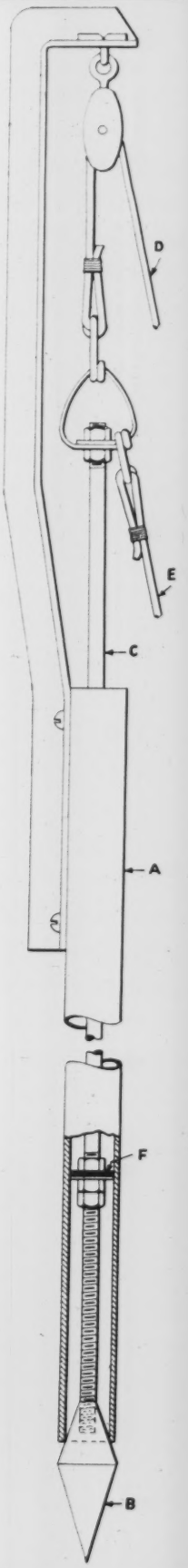
(Awarded $10 bonus for July)

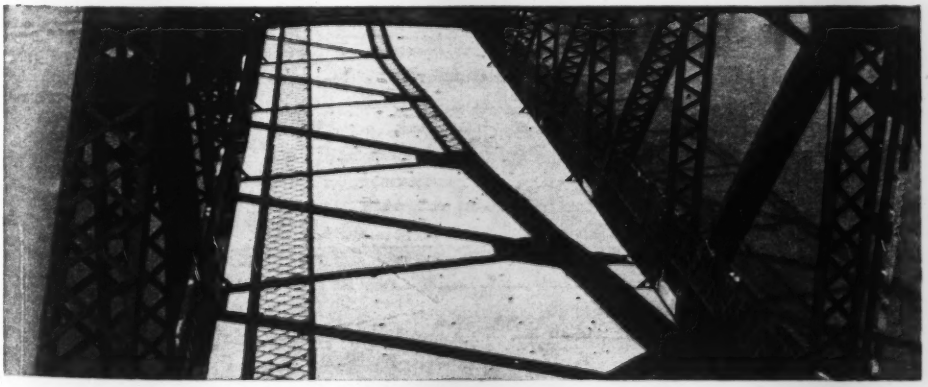
On a project involving hydraulic sand fill over mud flats, the sampling device illustrated was found very useful in determining junctions between sand, mud and other materials in situ, both before the fill was placed and after the fill had been superimposed on the mud. In particular, it enabled a study of the movement of the mud under the displacing effects of the fill to be expeditiously and economically made.

The apparatus in the form shown is limited to depths of about 20 ft., but its depth range could be considerably increased if some supporting and lifting device, such as an A-frame, were used. Its practical use is limited to securing samples of soft or loose materials.

The sampler consists essentially of a length of 1-in. pipe *A* (tubing would be lighter but more expensive and not so readily available on the ordinary construction job), with a plumb-bob-shaped combination point-and-stopper *B*, controlled by the ⅜-in. rod *C*, which in turn is actuated by the lines *D* and *E*. The leather-packed washers *F* prevent earth samples from being forced far up into the pipe, where they would be troublesome to remove. These washers are so located that they nearly reach the end of the pipe when the rod is pushed to its extreme downward limit, thereby ejecting the sample.

In use, the point-and-stopper *B* is brought up on the bottom edge of the pipe, closing the pipe, and the whole apparatus is forced down by hand to the point at which it is desired to secure an earth sample. At such point, the point-and-stopper *B* may be forced down ahead of the end of the pipe by pulling down on the small line *E*, and then pushing the pipe down until is it again seated on the stopper, entrapping an earth sample, when the whole apparatus is withdrawn. Tension is maintained on the line *D* while the sampler is being lifted, to hold the stopper in its seated position, thereby preventing loss of the sample. The sample is removed by pushing the rod *C*, which, through the agency of the leather-packed washers, ejects the sample.





Precast concrete slabs of light-weight aggregate replace old timber deck.

BOOK NOTES AND REVIEWS

The month's additions to the engineer's reading and reference list

Railroad History

MEN AND IRON: The History of New York Central—By Edward Hungerford. 424 pp. Published by Thomas Y. Crowell Co., New York. Price $3.75.

Railroad fans are indebted to Edward Hungerford for another absorbing history of railroad development, this time the New York Central Railroad. The present book supplements and amplifies the "Beginnings of the New York Central" by Frank W. Stevens (*ENR, March* 17, 1927).

No railroad history heretofore written has given such informative details of operating methods in the early days of development as are found in Hungerford's record of early days on those little railroads that now are welded into the New York Central. Included are such details as how train crews worked and how they were paid, how schedules were developed and how trains were run. Timetables are given as are passenger fares. In the early days of the Hudson River Railroad there were first and second class passengers and fares were varied between classes and between seasons, summer fares being lowered to meet steamboat competition. Rates were higher on the fast trains.

Construction problems are not overlooked. John B. Jarvis, chief engineer of the Hudson River Railroad, had no experience record to guide him when he began building substantial embankments across the deep silt-filled bays along the river. How he met that and like new problems is adequately described.

But the book is most fascinating for the light it throws on the personalities and politics of the half century or more between the building of the Mohawk & Hudson and the completion of the New York Central system. Interest of course centers on Cornelius Vanderbilt, but there are many others whose strong characters add spice to the tale. In the early days the strongly entrenched canal and steam-boat interests used their political power to hamper the young railroads; in the days after the Civil War the political byplay was between the railroad magnates themselves.

The book treats of the original New York Central, the lines east of Buffalo; the story of the lines west, except as they relate directly to the formation of the parent company, are left for another volume. The original New York Central was formed through a consolidation of several small railroads that spanned the state from Albany to Buffalo. Later were added the New York & Harlem, the Hudson River R.R., the West Shore, the Rome, Watertown & Ogdensburg, the Boston & Albany, Lake Shore & Michigan Southern, Michigan Central, the Big Four, and the Pittsburgh & Lake Erie.

Engineering Economics

BUSINESS ADMINISTRATION FOR ENGINEERS—By C. Francis Harding and Donald T. Canfield. 637 pp. Published by McGraw-Hill Book Co., Inc., New York and London. Price $5.

Engineering is often regarded as an exact science, but certainly there is nothing exact about the economics of engineering. Economics alone is based on the proposition "Will it pay?" However, when engineering sense is brought into play in connection with economics the proposition is expanded to include such questions as "Why do it at all?" "Why do it now?" "Why do it this way?"

Every engineering problem involves economics. Costs, values, returns, financial organization and management are as important to engineering as mechanics of materials, surveys and mathematical formulas. To provide at least a basic knowledge of economics the authors have written a readable, understanding book with thought-provoking questions closing each chapter. The reader is carefully led through the maze of corporation financing, management, accounting, dividends and other returns, and through the intricacies of valuation and depreciation. As both authors are professors of electrical engineering at Purdue, it is natural that they draw heavily on public utilities for their examples and descriptions. They even branch off into the fields of municipal ownership and public utility regulation. Written primarily for the engineer and specifically for the electrical engineer, the authors have succeeded in compiling a work of value to everyone interested in the fundamentals of business.

Water and Sewerage

WATER SUPPLY AND SEWERAGE—By Ernest W. Steele. 653 pages. Published by McGraw-Hill Book Co., New York and London. Price $5.

Comprehensive treatment of essentials in both water supply and sewerage practice is the aim of this one-volume book. The job is well done. Designed principally for use by engineering students, the presentation includes, nevertheless, so much of the newer developments in both fields that it should serve as an up-to-date reference source for practicing engineers.

In the section devoted to water supply it is particularly gratifying to note that the Hardy Cross method of analyzing flow distribution is described and its application illustrated by means of a typical example. This new and simplified scheme for design and investigation studies is of such fundamental importance that it is deserving of the emphasis placed on it. Sewage treatment principles and practices are adequately discussed from the viewpoint of one who is intimately acquainted with the rapid strides being made in this field. As a practical, concise and up-to-the-minute treatise covering two broad fields of sanitary engineering, this book has special merit.

Timber Preservation

WOOD PRESERVATION—By George M. Hunt and George A. Garratt. 457 pp. Published by McGraw-Hill Book Co., New York and London. Price $5.

A wealth of practical information concerning preservative treatment of timber is contained in this book. Years of study of wood preservation by such agencies as the American Wood Preservers Association, the American Railway Engineering Association and the U. S. Forest Products Laboratory have produced much

valuable data as to the various methods of preservative treatment and the results that may be expected, but it is widely scattered and not in easily usable form. In this book the information needed by engineers in specifying or designing timber structures, by purchasing agents in appraising claims for various methods of preservative treatment, or by students in gaining a knowledge of the art has been assembled in convenient form. Factors to be considered in specifying preservative treatment are outlined, as are the effects of preservatives on physical properties of wood, cost of treatment and probably increase in life of various classes of timber. Causes of decay and principal methods of preservative treatment are described. There is also a chapter on fire-retarding treatments.

It is of interest to note that just a century has elapsed since three major patents for wood preservation processes were issued, although preservative treatment had been tried as early as 1705. The Bethell process, on which our present full-cell treatment is based, was patented in Great Britain in 1838. The same year a patent on the use of zinc chloride was issued to William Burnett in England, and in France the Boucherie process of treating standing or freshly cut timber was patented. All three of these processes are still in use in modified forms.

MISCELLANEOUS NOTES ON BOOKLETS AND REPRINTS

INDUSTRIAL ACCIDENT AND DISEASE PROBLEMS discussed at the 1937 convention of the International Association of Industrial Accident Boards and Commissions, are reported in Bulletin No. 17, issued by the U. S. Department of Labor. Copies may be obtained from the Superintendent of Documents, Washington, D. C., at 25 cents each.

PERSONNEL AND INDUSTRIAL RELATIONS PRINCIPLES AND PRACTICES. A series of papers presented at the Industrial Personnel Institute held at Purdue University in 1937, have been published as Extension Series Bulletin No. 41, Purdue University, Lafayette, Ind.

PRESSURE LOSSES resulting from changes in cross-sectional area in air ducts is the subject of Bulletin No. 300 published by the University of Illinois Engineering Experiment Station, Urbana, Ill. Price 65 cents.

PLUMBING CROSS CONNECTIONS AND BACK SIPHONAGE RESEARCH, a report by F. M. Dawson and A. A. Kalinske, State University of Iowa, has been made available as Technical Bulletin No. 1 of the National Association of Master Plumbers of the U. S., Inc., Washington, D. C.

SUGGESTIONS AND PRECAUTIONS to be observed in placing vibrated concrete, and illustrations of the types of commercial vibrators available, are given in a new booklet published by the Portland Cement Association, 33 W. Grand Ave., Chicago, Ill.

RESEARCH CONCERNING HORIZONTAL PRESSURES on retaining walls due to concentrated surface loads, is the subject of Bulletin 140, published by the Iowa Engineering Experiment Station, Ames, Ia.

SEMI-PLANT SCALE STUDIES of chemical precipitation of sewage are outlined in Bulletin No. 45 of the Texas Engineering Experiment Station, College Station, Tex.

SANITARY REQUIREMENTS FOR SWIMMING POOLS AND BATHING PLACES are presented in a manual issued by the Illinois State Department of Health, Springfield. Information and suggestions on design, construction and operation of pools is also included.

EFFECTS OF HIGH VOLTAGE ON THE BACTERIAL CONTENT OF MILK is the subject of Bulletin No. 3 of the Engineering Experiment Station, University of Nevada, Carson City, Nev.

STREAM POLLUTION SURVEY METHODS, regulations governing water and sewage plant operators, and papers presented at the Ohio Conference of Sewage Treatment, are contained in the eleventh annual report. Copies may be obtained at $1.25 each from F. E. Harroun, Room 501, Municipal Building, Akron, Ohio.

OPPORTUNITIES FOR STUDY AND RESEARCH in engineering health service are described in a pamphlet issued by the Harvard Graduate School of Engineering. Copies may be obtained by addressing Prof. Gordon M. Fair, Pierce Hall, Harvard University, Cambridge, Mass.

INSTRUCTIONS FOR CONDUCTING STREAM AND LAKE SURVEYS, Fishery Circular No. 26, U. S. Department of Commerce, can be had from the Superintendent of Documents, Washington, D. C., price 10 cents.

NEW PUBLICATIONS

THE STRUCTURE OF STEEL (Simply Explained)—By Eric N. Simons and Dr. Edwin Gregory. 115 pp. Published by Prentice-Hall, Inc., (printed in England). Price $2.00.

STRUCTURAL DESIGN—By Carlton T. Bishop. 254 pp. Published by John Wiley & Sons, New York, and Chapman & Hall, London. Price $3.50.

THE TENNESSEE VALLEY AUTHORITY—By Clarence Lewis Hodge. 272 pp. Published by The American University Press, Washington, D. C.

PROCEEDINGS—Eleventh National Asphalt Conference—Held under the auspices of The Asphalt Institute and The Association of Asphalt Paving Technologists. 176 pp. Published by The Asphalt Institute, 801 Second Avenue, New York, N. Y. Price $1.00; reprints of individual papers free on request.

DER GRUNDBAU—By L. Brennecke and Erich Lohmeyer. 246 pp. Published by Wilhelm Ernst & Sohn, Berlin. Price 15.75 RM.

ASPHALTS AND ALLIED SUBSTANCES (Fourth Edition)—By Herbert Abraham. 1,491 pp. Published by D. Van Nostrand, Inc., New York. Price $12.50.

HOUSING COMES OF AGE—By Michael W. Straus and Talbot Wegg. 259 pp. Published by the Oxford University Press, New York. Price $2.75.

ENGINEERING TERMINOLOGY—Definitions of Technical Words and Phrases—By Victor J. Brown and Delmar G. Runner. 310 pp. Published by Gillette Publishing Co., Chicago, Ill. Price $3.50.

PARK AND RECREATION STRUCTURES—Part I: Administration and Basic Service Facilities; Part II: Recreational and Cultural Facilities; Part III: Overnight and Organized Camp Facilities.—Prepared by National Park Service, U. S. Department of the Interior. 200, 212, and 192 pp., respectively. For sale by the Superintendent of Documents, Washington, D. C. Price 75c. each (paper cover).

Contractor Loses Damage Suit

H. H. Sears
New York, N. Y.

City of Osceola, Iowa, recovers damages to dam which partly failed within year of completion

The city council of Osceola, Iowa, retained the right to give its final acceptance of the completed dam built for its reservoir under the provision of Chapter 452 of the state laws. The city engineer's final acceptance of the construction of the dam, under his supervision, did not prevent the city from securing judgment against the contractor and his surety for the cost of repairing the spillway which was damaged by high water within one year from the date the engineer had reported the construction completed in 1934. The contractor had agreed to furnish a water-tight structure and this defect in the spillway was attributed by the court to undiscovered defects in workmanship. This gave effect to the state statute requiring one year to elapse before the contractor and his surety were released from claims for damages by the city.

This particular dam was constructed of earth, 510 ft. long and about 25 ft. high, with the crest of the spillway about 5 ft. below the crown of the dam. Concrete slabs, 8 x 8 ft., 4 in. thick, covered the upstream side of the dam and extended across the spillway, at the west end. Excessive drought in 1934 caused the earth to settle under the spillway slabs, and flood waters in January 1935 undermined the spillway. The city repaired it as an emergency measure and then successfully sued the contractor and the surety for damages claimed as $10,000. This amount was reduced by the court to $2,500 with interest and court costs, and the court allowed the contractor a credit of $938, as reinforcement costing that sum had been placed in the spillway curtain walls in excess of the specifications. (City of Osceola Versus Gjellefald Const. Co. 279 N W Rep. page 590: Supreme Ct. Iowa, Apr. 10, 1938).

The court referred to Vol. 19 Ruling Case Law, Page 1076: Par. 361-Municipal Law, the Conclusiveness of the Engineer's Certificate as to Performance: (Quoting text from opinion—in part)—

"It is usually provided in contracts for the construction of public works entered into by municipal corporations that the work shall be done under the supervision of the city engineer and that no payment shall be made except upon his certificate that the work has been properly performed, and it is well settled that the approval of the work by the city engineer under whose supervision a contract for public improvement is to be performed will, in the absence of fraud or concealment which prevents a discovery of imperfections, estop the municipality from contesting the contractor's right to the contract price because of failure to perform the work according to the specifications, so far as defects are concerned which were discoverable by reasonable attention to the duties of inspection, but when the decision is arbitrarily made, or bad faith and fraud appear the decision is not conclusive against the municipality. So in the absence of proof of fraud, acceptance by a city of authorized contract work, upon the certificate of a public officer that it was rightly done, is prima facie evidence in favor of the city as to the completion and manner in which the work was performed.—The authority of the engineer is limited to questions of fact: he has no power to conclude the parties by his decision upon questions of law.——."

The city won its suit by virtue of this law and the contractor's agreement to build a watertight job.

San Francisco's Successful Financial Management

Finance and accounting procedures which give San Francisco successful management of its purse strings are held out as a guide for other large cities and counties in a manual published by the Municipal Finance Officers' Association of the United States and Canada.

While other cities wrestle with problems of tax delinquency, unbalanced budgets and costly financing, the combined city and county of San Francisco had only 1.5 per cent tax delinquency at the end of the last fiscal year. Its total tax collections in 1936-1937, including delinquencies, amounted to 100.9 per cent of the year's levy. Bonds issued during the last two fiscal years cost the city an average net interest of only 2.68 per cent.

San Francisco, according to the report, is one of the few public bodies which has reduced finance department instructions to detailed written form, and has clearly defined lines of authority. The present accounting system has been developed since the new charter became effective in 1932. The charter provided for a controller whose duties and powers are specifically stated. This finance officer is appointed by the mayor with the approval of the board of supervisors and can be removed only by a two-thirds vote of the board.

The controller is held strictly responsible for the condition of San Francisco's pocketbook. He must approve all commitments and expenditures, and is charged with the duty of keeping all expenditures within realized revenues. If current receipts fail to cover cash requirements of some department, the only alternative is a loan from the cash reserve fund provided in the charter. This fund has been built up through delinquent tax collections and now totals more than $2,800,000.

Unusual among the controller's duties is the requirement that he learn the unit cost of city and county activities to determine whether similar work could be performed more cheaply under private contract. The controller's staff also supervises departmental accounts.